

DIO-ELECTRONIC ENGINEERING EDITION

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RADIO & TELEVISION NEWS

AUGUST
1953

THIS ISSUE

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TV TUBES

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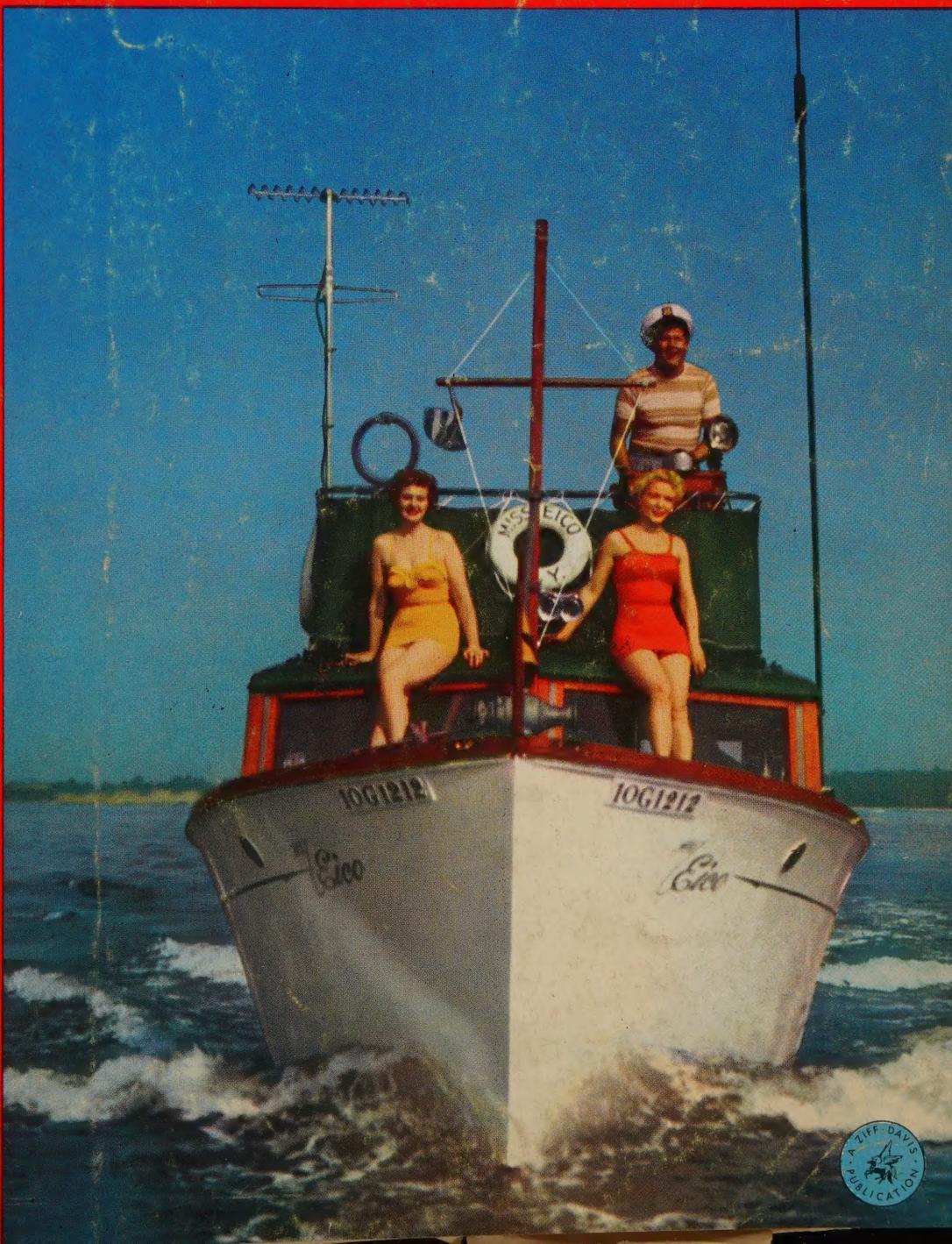
THE E-V REGENCY

R 1953 EMERSON
RECEIVERS

SIMPLE
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ONICS FOR THE
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Page 67



A ZIFF DAVIS
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An RCA Tube starts working for you from the instant the customer first sees the familiar red, black, and white carton. You have her confidence from the start, because she knows and respects the RCA trademark.

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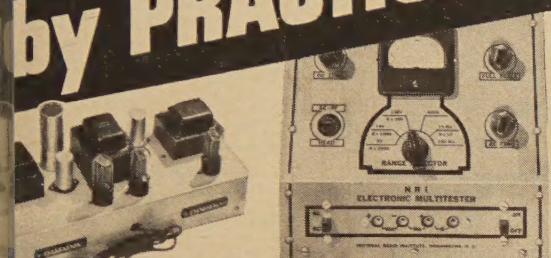
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A Federal Communications Commission Commercial Operator's License puts you in line for a good job in Radio or Television Broadcasting, Police, Marine, Aviation, Two-way, Mobile or Micro-wave Relay Radio. Mail coupon below for 64-page book FREE. It will give you complete facts about my NEW Communications course.

YOU BUILD THIS TRANSMITTER

with parts I send. With this Transmitter you practice how to put a station "on the air." You perform procedures demanded of Broadcast Station Operators, conduct many experiments, make many practical tests.

LEARN COMMUNICATIONS by PRACTICING at Home in Spare Time



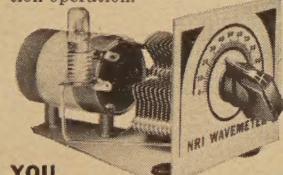
YOU BUILD

Transmitter Power Supply in the basic experiments in AF amplifiers, frequency multipliers, buffers, etc.



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Ref Technician
Ref Operator
Over Monitor
Recording Operator
Remote Control Operator
RADIO
Ref Operator
istant Operator
disteophone Operator

GOVERNMENT RADIO
Operator in Army, Navy, Marine Corps, Coast Guard
FOREST AND HARBOR
Forest Service Dispatcher
Airways Radio Operator

AVIATION RADIO
Plane Radio Operator
Airport Transmitter Operator
TELEVISION
Pick-Up Operator
Voice Transmitter Operator
POLICE RADIO
Transmitter Operator
Service Technician

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"My position with WNBT is video control engineer on the RCA color project. I owe a lot of my success to your textbooks." —Warren Deem, Malverne, N. Y.



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"A former employer recommended N.R.I. training. Now employed as transmitter operator at WKBO." —Albert Herr, New Cumberland, Pa.



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If you prefer a good-pay job in Radio-Television Servicing . . . or your own money-making Radio-Television Sales and Service Shop, I'll train you at home. My famous Servicing Course also includes many Kits of Radio Parts. You use them to get PRACTICAL EXPERIENCE with circuits common to Radio and Television. I also show you how to make \$5, \$10 a week or more EXTRA MONEY fixing neighbors' Radios while training. Full information in my 64-page book. . . . Mail coupon.

want. If you've had some training in Radio or Radar, or as a Licensed Operator, my course modernizes, increases the value of your knowledge.

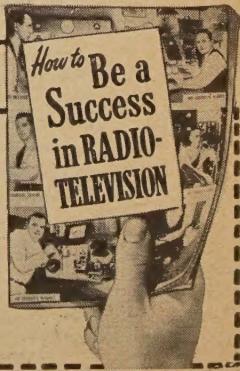
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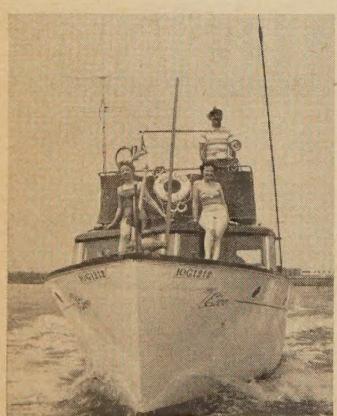
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COVER PHOTO: The "Miss Eico", a 31-ft. motor launch carrying an extensive array of radio gear. The boat offers remote control of its radiotelephone system on the flying bridge. (Ektachrome by Jay Seymour)

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AUGUST, 1953

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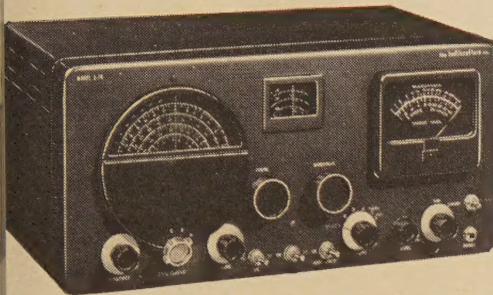
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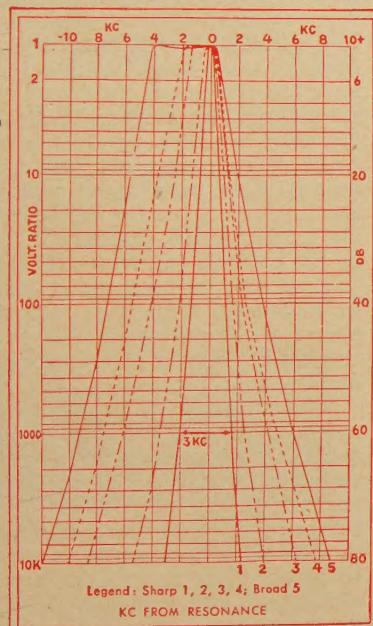
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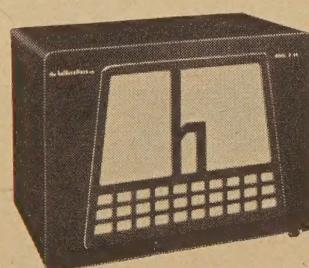
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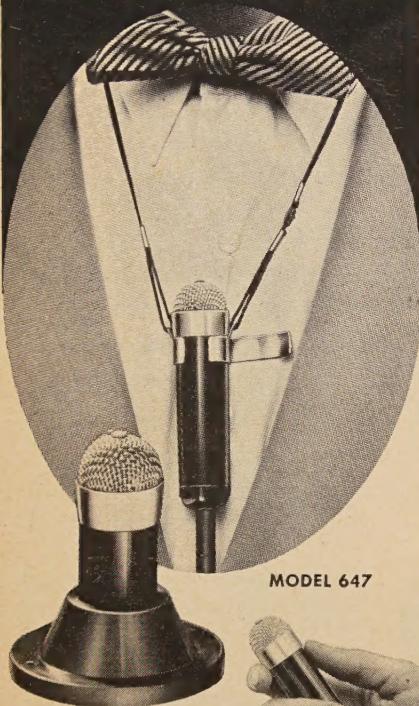


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For the RECORD.

BY THE EDITOR

ENGINEERING AND THE FUTURE

THE engineering profession, particularly in the electronics field, is riding at an all-time high. According to an analysis in a recent issue of the magazine "U. S. News & World Report," college graduates in general and engineering graduates in particular were never in greater demand. Students and young people would do well to analyze their aptitudes and talents in the light of this demand and seriously consider entering the field.

A year ago, the Survey Committee of Engineers Joint Council indicated a shortage of about 80,000 engineers. This shortage is gradually being reduced but there is still a demand for about 42,000 engineers a year, and the total number of engineering graduates this year will probably not exceed 21,000. A similar situation holds true for scientists.

The present salary scales for graduate engineers would make the old-timers who graduated during the depression really drool. The starting scale runs roughly \$350 a month, with extremes of as much as \$500 being reported. This is for men with very little or no experience, just getting out of school.

These factors make engineering a very attractive and promising field. The long-term trend still favors the engineer and with the rapid developments in electronics and other fields, this trend may even be accelerated.

There are many other factors that make the engineering field attractive. Here is a chance to get in on the ground floor of some of the most startling developments of modern times. Here is a chance to satisfy one's inherent thirst for knowledge regarding the "why's" and "wherefore's" of scientific knowledge. Here is a chance to do something really constructive—increase the standard of living, develop something "new" that gives a feeling of accomplishment.

One of the questions asked of our readers in a recent survey dealt with the "special interests," including those readers attending classes in college and in trade school. We found as a result that a total of 61,673 were presently studying subjects in electronics. Nearly 24,000 of these readers were going to a trade school and another 20,000 were attending college. The survey showed that more than 24,000 were currently studying engineering and nearly 17,000 were studying communications. It has been most gratifying to the editors that ever since World War II there has been an ever-increasing number of high school gradu-

uates entering the field of engineering as a profession.

In addition to these men, we find that over 25,000 of our readers are studying servicing. While the total of the above is but a drop in the bucket compared to the requirements of the electronics industry, it does show that these students are greatly augmenting the entire engineering profession in our electronic industry.

Our high schools are doing an excellent job of training students to enter engineering colleges but still more must be done to cut down on the mortality rate. The analysis mentioned above reveals that many students are deficient in math. Others have not been taught to work and to think. These factors are of supreme importance to the engineer, and must be recognized early by engineering students. Probably the major reason for this is the shortage of good high school teachers who are able to inspire their students to think and work.

Another factor which is rapidly entering into the engineering field is that of executive ability and training. More and more of the larger companies are drawing from their engineering staffs to fill executive positions. This means even greater opportunities for engineers in the years to come. It also means greater responsibilities, more intensive training, and the development of aptitudes not ordinarily required in engineering as such. These aptitudes come under the broad heading of executive ability. It used to be the common impression that executive ability, or lack of it, was born in a person. However, it has been proved time and again that this ability can be developed to a remarkable degree.

What does all this add up to? It means that more and more of our students in high school and college should seriously consider entering one of the various engineering fields. It means further that these students must learn to discipline themselves to work and to think. They must learn how to get along with other people—how to organize and direct various activities—how to get the utmost in cooperation from associates—how to handle problems in human relations. More attention to the humanities can perhaps assist in this direction.

This might appear to be a difficult road to travel, but the rewards more than justify the difficulties. The feeling of satisfaction resulting from a job well done is worth many a tedious hour of study and preparation... O. R.

Leonard C. Lane, B.S., M.A.
President of Radio-Television
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Spot Radio News

* Presenting latest information on the Radio Industry

By RADIO & TELEVISION NEWS'
WASHINGTON EDITOR

COMPATIBLE COLOR, which dazzled members of Congress during that striking Princeton show, at this writing is being readied for a grandstand appearance before the seven guardians of the airwaves, the Commission, by the folks who staged the demonstration in New Jersey, *RCA*. Originally, the industry committee studying color was scheduled to file a petition as a body. Now, according to company spokesmen, two petitions may be filed, with the NTSC delaying its presentation until the late Fall.

The early prospects for color have so excited broadcasters, that over thirty affiliates of *RCA*'s *NBC* net have signed affiliation contract supplements allowing them to carry colorcasts when the reds, greens, and blues begin coming over the coax. Among those who said yes, were *WBRE-TV*, Wilkes-Barre; *WSYR-TV*, Syracuse; *WJAC-TV*, Johnstown; *WLWD*, Dayton; *WLWC*, Columbus; *WLWT*, Cincinnati; *WSAZ-TV*, Huntington; *WDSU-TV*, New Orleans; *KSTP-TV*, St. Paul-Minneapolis; *WKY-TV*, Ok-

lahoma City; *KCBD-TV*, Lubbock; *WBAP-TV*, Fort Worth; *KPRC*, Houston, and *KPTV*, Portland.

According to the company's production experts, setmaking should be about nine months after government approval is received; thus sets may be available next Spring. However many have indicated, and quite strongly, that the Winter of '54, probably around Thanksgiving or Christmas looks like a more realistic date line for color-chassis deliveries.

In the meantime, NTSC task groups are pushing ahead with their exhaustive tests. Particularly active are the field panels which have members in New York, Chicago, Syracuse, Philadelphia, and Washington constantly probing and conducting all observation tests. Not only are concerned with the effectiveness of color reception, but the compatibility of chassis for viewing and listening too. According to the test procedure of one sub-committee, task groups responsible for official tests in strength signal, intermediate strength sig-

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL**	CHANNEL	FREQUENCY (m.c.)	POWER (Video)
Idaho	Meridian		2	54-60	16
Illinois	Rockford		13	210-216	195
Ohio	Cincinnati	WCIN-TV	54	710-716	89
Oregon	Eugene		13	210-216	56
Pennsylvania	Lancaster		21	512-518	18
Texas	Harlingen		4	66-72	13
"	Lubbock	KFYO-TV	5	76-82	100
Wyoming	Casper	KSPR-TV	2	54-60	1
Hawaii	Honolulu		4	66-72	58

REVISED CALL LETTER LISTING

(Since the publication of the listings last month, the following final TV call letters have been assigned to new stations by the Commission.)

STATE	CITY	CALL	CHANNEL	FREQUENCY
California	Fresno	KJEO	47	668-674
"	San Francisco	KSAN-TV	32	578-584
Florida	Lakeland	WOTV	16	482-488
Louisiana	Alexandria	KSPJ	62	758-764
Minnesota	Minneapolis	WTCN-TV	11	198-204
Michigan	Cadillac	WWTV	13	210-216
Missouri	Cape Girardeau	KGMO-TV	18	494-500
New Hampshire	Keene	WKNE-TV	45	656-662
Pennsylvania	Lancaster	WWLA	21	512-518
Tennessee	Knoxville	WCEE-TV	26	542-548
Texas	Victoria	KNAL-TV	19	500-506

*ERP = (effective radiated power, kw.). **Call letters without TV suffix from application files and subject to change; except where included in calls such as KKTU or WTWT.

... = Call letters to be announced

WE BELIEVE Norman Foster's recent advertisement in the Chicago "TV Guide" is of interest to the entire television and radio industry. Consequently, with Mr. Foster's permission, we are reprinting it here as a public service for every television and radio service technician in America.

Harry Kalker
(HARRY KALKER, President)

SPRAGUE PRODUCTS COMPANY
(Distributors' Division of the Sprague Electric Company)
North Adams, Massachusetts



NORMAN FOSTER

UNFORTUNATELY

Because of the Greed of a Few, THE ENTIRE TV SERVICE INDUSTRY MUST SUFFER

HERE IS WHAT I HAVE DONE TO GUARANTEE YOU HONEST TV SERVICE

The name, Foster Television is not taken from a street, a deck cards, or a country, and it is not an adjective. It comes from the name of its sole owner, Norman Foster. I have spent 22 years in the Radio, Electronics and Television service business, and in these years I have worked for just about every type of Operator, bad, bad and indifferent. When the time came that I could open my own business, I decided that because of the reputation that the Radio and Television repair business has always had, a company operating so honestly that they could invite their customers to the shop to watch their work being done could be a success. The volume of business we did last year proves I was right.

The reason that a service man would attempt to sell you something you do not need is because he had something to gain personally. Many Television service operators hire men, driving their own cars, on a percentage basis. This is advantageous because the service company can be in business with practically no investment. Under these conditions if this man needs money, it is only human nature that he is going to want to do the thing your television set that will make him the most money—whether it be 5 tubes or haul it to the shop.

Every man that I have, works by the hour and punches a time clock. He drives a company owned new truck bearing my name and his equipment and uniforms are furnished to him without charge. He has orders to repair your set in your home whenever possible. He receives the same amount of money whether he repairs 1 set or 10, and whether he charges \$1 or \$10. His rate of pay and his advancement are based on the number of sets he can pair in the home.

Our service call price is a flat \$3 and covers all labor necessary to make any repair possible in your home except cleaning a screen, for which we charge \$1 extra. It is evident that on this basis we do not make money on every job, but with the large volume of business we do, it has averaged out to a modest profit at the end of the year. You can bring your set into our shop and not only save this service charge, but also see it repaired while you wait. There is no minimum charge on this service. You pay only for the actual time spent on your set.



YOU CAN DEPEND ON

FOSTER TV
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Easier to use . . . lists replacements by manufacturer's model and chassis number and also by original part number.

Up-to-date . . . over 5600 models and chassis are covered, including virtually all sets built prior to 1953 as well as most 1953 models.

You'll save time and trouble when you use this valuable Stancor reference. Get it now from your Stancor distributor, or write us directly for your free copy.

Five new Stancor exact replacement flyback transformers. Many of these units are the result of recommendations of the Stancor Servicemen Advisory board, composed of the top TV servicemen throughout the country.

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Stancor Part No.	Exact Replacement For	No. of Models Using Flyback
A-8137	Hoffman #5035	29
A-8220	Philco #32-8555	24
A-8221	Philco #32-8565	18
A-8222	Philco #32-8533 & #32-8534	38
A-8223	Philco #32-8572	15

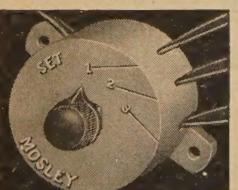
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EXPORT SALES—Roburn Agencies, Inc., 39 Warren St., New York 7, N. Y.

MOSLEY 3-WAY TV ANTENNA SWITCH

for Multiple



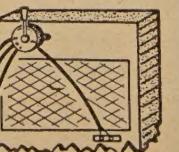
Cat. No. F-20 — MOSLEY
3-Way TV Antenna Switch
List Price \$3.75

UHF and VHF ANTENNA INSTALLATIONS

- Install anywhere. Extension rod supplied for back of set mounting.
- Constant impedance—Low loss—Solderless.
- Sturdy rotary switch making silver-to-silver contact.
- In brown or ivory polystyrene case.
- Also available in Flush Wall Plate style.

At Radio Parts Jobbers

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and fringe signal areas. For the intermediate signal-strength tests, signals between 3000 and 10,000 microvolts are required.

In studying the signals, eight tests are made for resolution, over-all picture quality, flicker, brightness, contrast, picture texture, adequacy sync, and sound quality. The over-picture quality report, it is said, reveals the general impression a picture makes on the observer, and also such defects as poor focus, streaking, beats, or noise, appear. In scrutinizing picture texture, observers are required to look for dot structure, crawl, moire, or beat patterns in the picture. Viewers are warned that they must look carefully to see if they recognize any limitations in subject matter. They are also obliged to look for evidence of brightening of the horizontal retrace lines due to presence of color sync signals, and make a record of such observations for several possible settings of the horizontal hold control, with brightness control set for best monochrome picture.

A novel scoring technique has been prepared to permit an evaluation of observed results. Two scales are provided, and a series of numbers from one to six to simplify identification. To illustrate, not perceptible represents condition 1; just preceptible, definitely perceptible, but not objectionable, 3; somewhat objectionable, 4; definitely objectionable, 5; and not usable, 6. In the second scale, which is complementary, 1 means excellent, 2, good; 3, passable; 4, not quite passable; 5, poor; and 6, not usable.

The comprehensive tests also involve detailed studies of such problems as susceptibility to co-channel and adjacent-channel interference. In the former test, a lab signal generator is modulated with a signal from a scanner or other pickup equipment in accordance with the NTSC proposal, and applied to a color set. Then an interfering signal is applied to the set at a -40 db level. Signals at non-sync, co-channel type and the receiver picture is evaluated for the effects of this interference. A performance comparison is also made with operation of a black and white signal under similar conditions. The tests are repeated with offset carrier operations at a -28 db level.

Everyone in industry and Washington is well aware of the thoroughness of the work of these task groups, and certainly their efforts will play a major role in producing better color casting and viewing.

GLOBAL TV, a doodling idea for years, which last Spring captured the fancy of Washington legislators and prompted the evolution of a blueprint for a North Atlantic Treaty Organization, plus the introduction of a bill in the Senate to establish a Commission on Cooperative International Relations, which would encourage existing agencies . . . "to design . . . a

(Continued on page 111)

LUMPED-CONSTANT DELAY LINES

By
C. L. FRUCHTER
Tel-Instrument Co., Inc.

FOR many years, design engineers have been confronted with the problem of storing or delaying information for short intervals of time. Here the magnitude of the delay is of the order of microseconds, an electrical network in the form of a low pass filter usually represents the simplest and most economical means of attaining the delay. The mathematical computations required in the design of such filters, with specified characteristics such as total delay, impedance, or rise time, are easily accomplished; however, choosing the proper approach and design constants is often difficult.

There is a fair amount of literature on this subject scattered throughout the technical books and periodicals of the last twenty years. An engineer who studies this literature may well become confused since not only does the terminology differ from paper to paper but optimum design constants chosen by the many authors vary considerably.

The characteristic impedance of a delay line is defined as:

$$Z_0 = \sqrt{L_0/C_0} \quad \dots \dots \dots \quad (1)$$

and the cutoff—or resonant—frequency, in cycles, is:

$$f_c = 1/\pi \sqrt{L_0 C_0} \quad \dots \dots \dots \quad (2)$$

Figure 5 represents two midsections of a delay line, using a π configuration, and the corresponding end sections. The number of midsections in a delay line of this kind determines the total delay. There is assumed to be no coupling between the coils L_0 . The series inductance of a single section of this line and the shunt capacitance of each section can be obtained from Eqs. (1) and (2), and are:

$$\tau_s = Z_0/\pi f_c \quad \dots \dots \dots \quad (3)$$

$$C_0 = 1/\pi f_c Z_0 \quad \dots \dots \dots \quad (4)$$

This type of line is called a constant filter and has the property that the

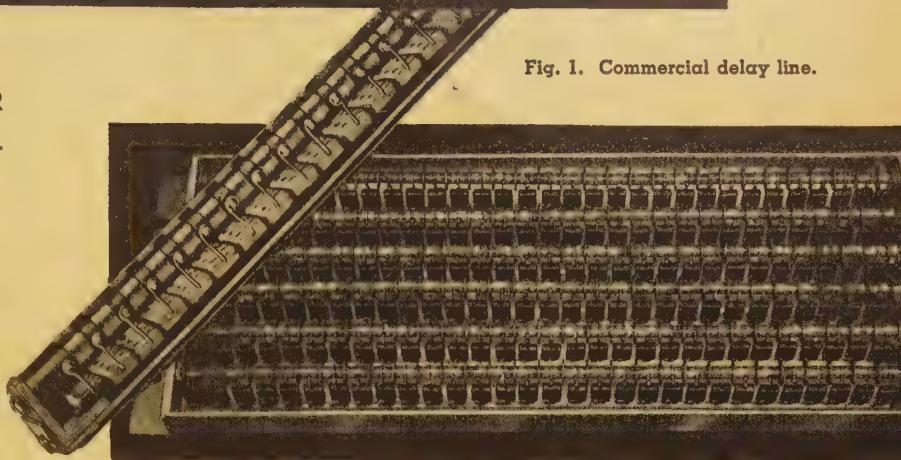


Fig. 1. Commercial delay line.

Fig. 2. A 30-section delay line which forms part of a television synchronizing signal generator. Each section has a delay of 0.1 μ sec.

Design of filters incorporating a specified amount of delay with desired frequency and phase response.

amplitude-frequency characteristic of the impressed wave is independent of frequency between the frequency limits of 0 and f_c , when the line is terminated in its characteristic impedance. The delay per section, τ_s , of the line is equal to $2/\omega_c$ when ω is very much smaller than ω_c . This requirement, however, severely limits the usefulness of this network since the delay per section is inversely proportional to the cutoff frequency. Relatively long delays, of the order of 5 or 10 microseconds, and a high cutoff frequency, of the order of several megacycles, are often impractical requirements with a constant k line. As a further design restriction, it should also be noted that the lower the characteristic impedance, the smaller the inductance L_0 becomes, and therefore the smaller the physical size and attenuation of each section. Over a limited range, the value of C_0 has a very small effect on either of these two parameters.

The design procedure is fairly simple. Usually the total delay is known as well as the line's application, and sometimes the characteristic impedance is specified. Where good reproduction of pulses is required, as high a value of f_c should be chosen as is possible with-

in the physical limitation of size, since the higher the f_c value, the greater the number of sections for a particular delay. Each coil should be spaced from its neighbors by at least one coil diameter to minimize the coupling. If Z_0 is not specified, a value should be chosen which is as low as possible (usually in the range of 50 to 2000 ohms) and L_0 and C_0 computed. The delay per section can be calculated and is:

$$\tau_s = \sqrt{L_0 C_0} \quad \dots \dots \dots \quad (5)$$

The number of sections required is then:

$$n = \tau/\tau_s \quad \dots \dots \dots \quad (6)$$

A line composed of many sections should have its cutoff frequency increased¹ by a factor of $n^{1/2}$ to reduce the total distortion. With this new value of f_c , which will be called f'_c , the values of L_0 , C_0 , τ_s , and n should be recalculated. The value of f'_c should then be divided by $n^{1/2}$ and a value close to the original f_c obtained.

The line shown in Fig. 5 does not include any matching device to either the termination or the source, and often none is needed. The capacitor $C_0/2$, however, does make it easier to add

Fig. 3. Square wave "pre-shoot."



Fig. 4. A 100-kc. square wave before (left) and after (right) being delayed.



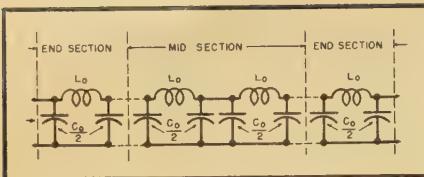


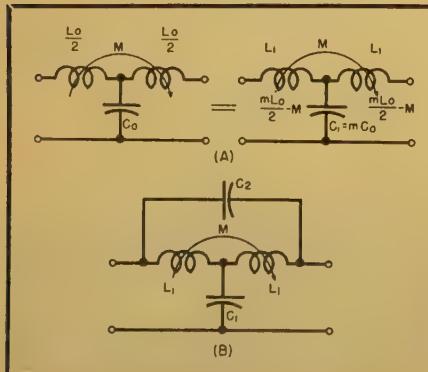
Fig. 5. Two midsections and corresponding end sections of a delay line.

lines in series than would be the case if the line were ended in an $L_0/2$ section or a matching section. Where a matching network is required, any of the conventional methods can be used, e.g., a half-section.

One of the properties quite often needed in a delay line is a constant delay over a wide frequency range. This property therefore requires that the phase rotation through the line must be exactly proportional to frequency since the slope of the phase angle vs. frequency curve is the transmission time delay. There remain two other forms of distortion which are important—amplitude and phase intercept distortion. The phase intercept distortion vanishes when the phase angle curve approaches and intercepts the zero frequency ordinate at an angle of 0° or any whole multiple of π radians. This form of delay distortion is found at frequencies very much lower than f_c . Batchelder, in his patent,² uses a physical conductance across the shunt capacitor to reduce this distortion, which in general is not very serious. Some amount of amplitude distortion is present in all lines, and not too much can be done to avoid it. However, it can be greatly reduced by carefully controlling the allowable tolerances on the inductance and capacitance of the individual elements. Making the capacitance controllable, by the use of trimmer capacitors which can be adjusted for the best over-all response, is one means of compensating for element variations.

The next step from the constant k line, which exhibits a large variation in delay with frequency, is the m -derived line as indicated in Fig. 7A. Here

Fig. 7. (A) An m -derived delay line with mutual coupling between coils. (B) An all-pass bridged T delay line.



the two coils are so placed physically that there is an inductive coupling between them, with the values of L_0 and C_0 modified by a factor m to retain the same cutoff frequency and characteristic impedance as exist in the constant k line. The same relationships exist as indicated in Eqs. (1) through (4) as well as those relating L_0 , M , the coefficient of coupling K and the modifying factor m .

$$M = \frac{1 - m^2}{4m} L_0 \quad \dots \dots \dots \quad (7)$$

$$L_1 = \frac{m L_0}{2} - M = \frac{m^2 + 1}{4m} L_0. \quad \dots \dots \dots \quad (8)$$

$$K = \frac{M}{L_1} = \frac{m^2 - 1}{m^2 + 1}. \quad \dots \dots \dots \quad (9)$$

$$C_1 = m C_0. \quad \dots \dots \dots \quad (10)$$

The delay per section, τ_s , is:

$$\tau_s = \frac{m}{\pi f_c}. \quad \dots \dots \dots \quad (11)$$

If n is the number of sections, then the total delay is $n\tau_s$, and if f_c is increased by a factor of $n^{1/2}$, an expression

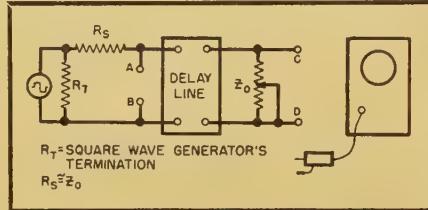


Fig. 6. Method for measuring the delay and characteristic impedance of a line.

for n in terms of the total delay can be derived:

$$n = \left[\frac{\pi f_c}{m} \tau \right]^{3/2}. \quad \dots \dots \dots \quad (12)$$

This method, however, sometimes requires entirely too many sections, and so an approximation is used as illustrated in the typical problem presented later. This approximation is usually more than adequate.

The angle of the phase shift through one T section is:

$$\begin{aligned} \beta &= 2 \sin^{-1} \frac{m \omega / \omega_c}{\sqrt{1 - (\omega / \omega_c)^2 (1 - m^2)}} \\ &= T \omega \text{ radians}. \quad \dots \dots \dots \quad (13) \end{aligned}$$

and the slope at any point of the curve of this phase angle vs. the ratio ω / ω_c is the time delay, $T \omega_c$ seconds, for each section, between the limits of $f = f_c$ and $f = 0$, and is expressed by:

$$\begin{aligned} \frac{d\beta}{d(\omega / \omega_c)} &= \frac{2m}{\sqrt{1 - (\omega / \omega_c)^2} \left[1 - \left(\frac{\omega}{\omega_c} \right)^2 (1 - m^2) \right]} \\ &= T \omega_c \text{ seconds}. \quad \dots \dots \dots \quad (14) \end{aligned}$$

A form of line which exhibits a more constant impedance between the limits of $f = f_c$ and $f = 0$ is the all-pass bridged T line (BT). Here all the parameters are identical with the T except for the bridging capacitor C_2 which is

across both coils L_1 , as indicated in Fig. 7B.

The phase shift of one section of the BT is:

$$\beta = 2 \tan^{-1} \frac{m \omega / \omega_c}{1 - (\omega / \omega_c)^2} = T \omega \text{ radians} \quad \dots \dots \dots \quad (15)$$

and the delay is:

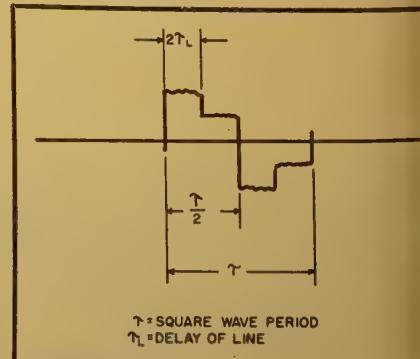
$$\begin{aligned} \frac{d\beta}{d(\omega / \omega_c)} &= \frac{2m \left[1 + \left(\frac{\omega}{\omega_c} \right)^2 \right]}{\left[1 - \left(\frac{\omega}{\omega_c} \right)^2 \right]^2 + m^2 \left(\frac{\omega}{\omega_c} \right)^2} \\ &= T \omega_c \text{ seconds}. \quad \dots \dots \dots \quad (16) \end{aligned}$$

Figure 10 is a plot of the delay vs. ω / ω_c (Eqs. (14) and (16)) for some of the more commonly used values of m . The notation is that as given in Turner.³ Note that the curves for the T sections pivot about the points where $\omega / \omega_c = 0.6$ and $T \omega_c = 3.3$, and that the curves which are symmetrically located relative to these points are very near complementary, so that by the proper choice of m the delay distortion of the T can be approximately compensated by a BT line. As indicated on the graph, Turner chose an $m = 1.49$ value since this value allows all the coils to be identical.

A series of experiments was conducted to determine the effect of the value of m on the response of a line to a square wave with a fast rise time, at fundamental frequencies up to 1 mc. The cutoff frequencies of the individual sections of the many lines tested were between 7 and 12 mc., and the delay per section varied between .01 and .05 μ sec.; the total delay of all the lines varied between 0.25 and 0.8 μ sec., the characteristic impedance of the lines varied between 75 and 500 ohms, and the value of m varied between 1.11 and 1.52. The test procedure is given in the following paragraph.

A properly terminated square wave generator was connected to the line under test through a series resistor approximately equal to the characteristic impedance of the line, and the line was terminated in a pure resistance. Both the terminating resistor and the series resistor were carefully ad-

Fig. 8. Waveform on scope when using the technique indicated in Fig. 6.



st to minimize reflections at the ends of the line. The probe of a wide-band oscilloscope was connected across the last shunt capacitor and all of the unit capacitors had trimmers across them which were adjusted for the best over-all response. In the case of the T lines, capacitor C_2 is a trimmer which was also adjusted for the best over-all response.

Results of these tests indicated that the best reproduction of the input square wave could be obtained with a T line of $m = 1.50$, and that in most cases the higher the value of m , the better the response. The bridging capacitor was approximately equal to 0.12; however, an interesting phenomenon observed with almost all of these lines was a "pre-shoot" which occurred at the end of the square wave, as shown in Fig. 3. In some cases, the amplitude of the "pre-shoot" was sufficient to make the line unsatisfactory. It was found that this "pre-shoot," with regard to the BT line, either did not exist at all or was of extremely small amplitude. Further investigation showed that bridging small capacitors across individual sections of a T line reduced the amplitude of the "pre-shoot" until it was negligible. These capacitors have only a very slight effect on the line's time, frequency response, or delay. Kallmann⁴ has recommended an $m = 1.27$ value, and this value has found much use in recent designs. It will generally give good results and is recommended at least as a starting point. The value of f_c must be determined by either the end use of the line or from a knowledge of the type of signal to be sent through it. Moskowitz and Racker⁵ indicate a rule of thumb for calculating the maximum frequency of a pulse as equal to $1/2t_r$, where t_r is the rise time. They suggest that the f_c of each section

of the line be set at 1.22 to 2 times this value. Again the characteristic impedance should be chosen consistent with the circuit requirements and as low as possible.

An m of 1.27 gives constant delay out to 0.6 f_c . An m of 1.40, as suggested by Lester,⁶ shows a considerable variation in delay (see Fig. 10). Turner's combination of T and BT sections shows a fairly constant delay to about 0.85 f_c ; however, it does have the disadvantage of requiring another element. When the use of a BT line is contemplated, it should be remembered that the response of this type of line is still quite good at f_c where the delay distortion is considerable. As this distortion can be serious in many cases, the highest frequency component of the input signal should be well below f_c .

To illustrate the use of the foregoing equations, consider the design procedure for a T line of $m = 1.27$. Let the total delay be 1 μ sec., the highest frequency component 10 mc., and the characteristic impedance 200 ohms. Since the delay is constant to 0.6 f_c , f_c should be $10/0.6 = 16.67$ mc. The delay per section from Eq. (11) is 0.0243 μ sec. and the number of sections from Eq. (6) is 41. To obtain the same fidelity from the entire line as would be obtained from a single section, f_c should be increased by $n^{1/2}$, giving a new value for n of 140 sections.

The various constants of the line may be calculated as follows:

$$L_0 = \frac{Z_0}{\pi f_c} = 1.11 \mu\text{hy.}$$

$$C_0 = \frac{1}{\pi f_c Z_0} = 27.8 \mu\text{ufd.}$$

$$L_1 = \frac{m^2 + 1}{4m} L_0 = 0.572 \mu\text{hy.}$$

$$C_1 = m C_0 = 35.3 \mu\text{ufd.}$$

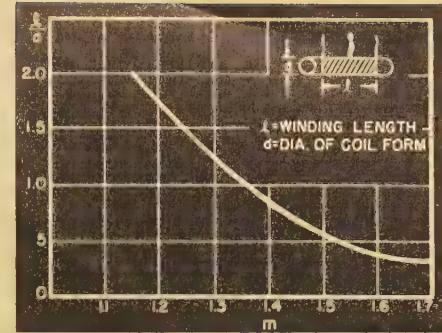


Fig. 9. Winding factor (length divided by diameter) for m -derived filter.

$$M = \frac{1-m^2}{4m} L_0 = -0.133 \mu\text{hy.}$$

$$L_T \text{ (total inductance)} = 2L_1 - (-2M) = 1.41 \mu\text{hy.}$$

One of the most convenient methods of obtaining the correct total inductance L_T is to wind both coils as a single layer solenoid of the proper winding length-to-form-diameter ratio (l/d). Figure 9 is a plot of the ratio of the winding length to the diameter of the coil vs. m . A form diameter is chosen, and the number of turns N is determined by:

$$N = \sqrt{\frac{85.8 L_T}{d}} \quad \dots \dots \dots \quad (17)$$

where d is the form diameter in inches, and L_T the total inductance of a single section in microhenries. The ratio l/d is found from Fig. 9 and the winding length calculated. By means of a wire table, the wire size that will give N turns in a length l is determined. The coil must be tapped at $N/2$; this can be done by winding half the coil, stopping the winding machine, forming a loop and twisting it tightly, and then continuing with the winding. Some care must be exercised in choosing a wire size. Wire smaller than #38 is some-

(Continued on page 26)

Fig. 10. Delay curves of T and bridged T lines.

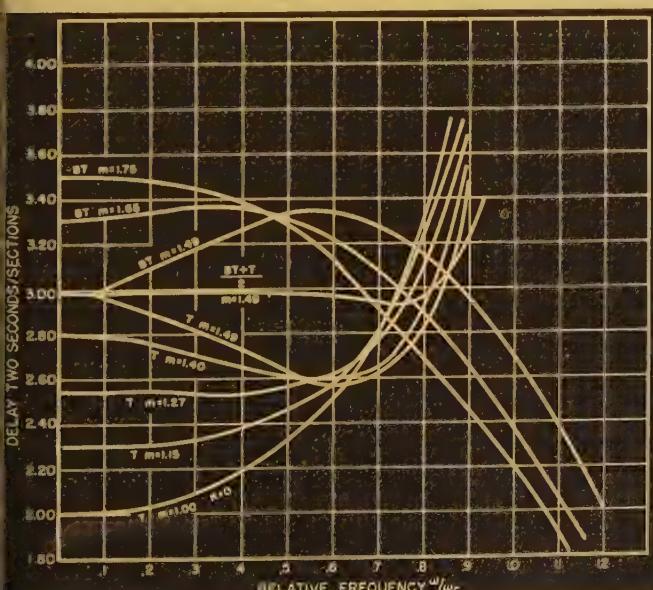
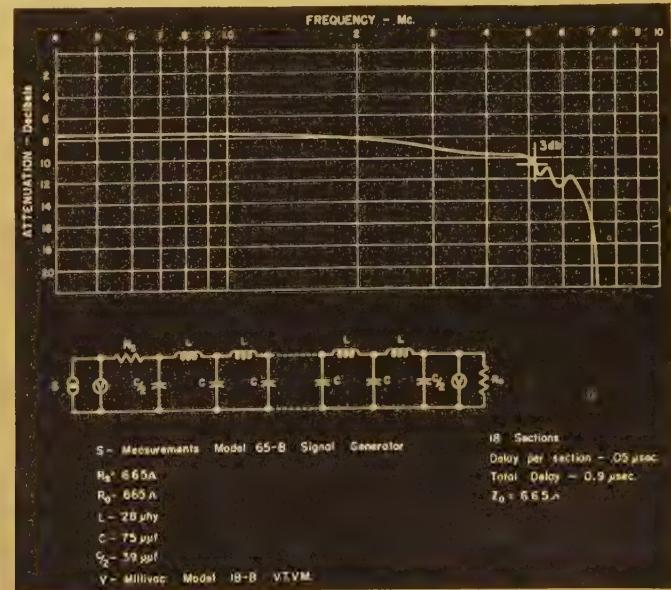


Fig. 11. Frequency response of line shown in Fig. 1.



PRESSURE TESTING OF TV TUBES

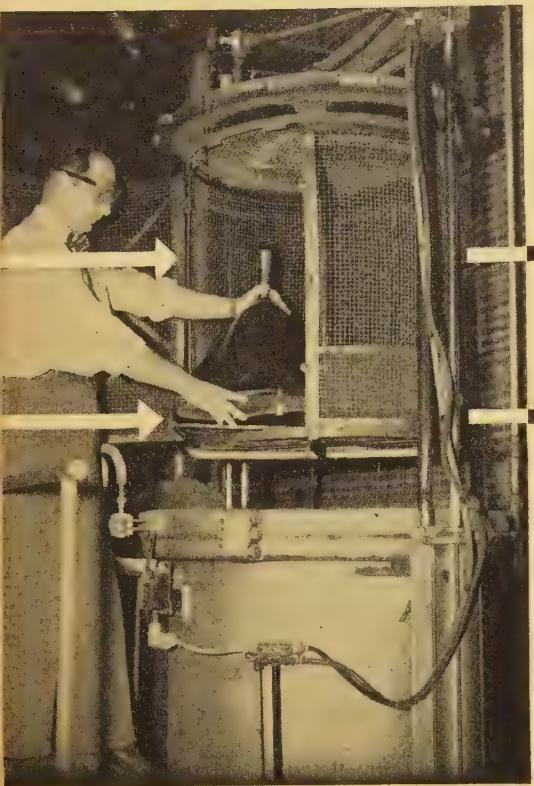


Fig. 1. Tube is placed in cage before being lowered into water pressure tank.

By G. D. OSTRANDER

Sylvania Electric Products Inc.

*The strength of metal or
glass TV picture tubes
may be checked by means
of air or water pressure.*

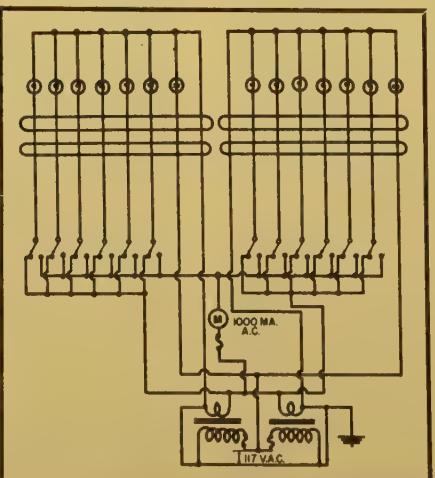
PREVIOUSLY published articles have pointed out many of the important factors which must be considered in the production of television picture tubes. Pictures and articles have been published concerning the importance of thorough testing and the many precautions necessary in manufacturing screens. Maintaining control of the critical spacings in the electron gun has been emphasized as well as the absolute necessity of insuring leakproof seals in the base. All these precautions, however, are of no avail if the bulb is not of the same high quality and built with the same care.

Much research in this basic field has been done by the bulb manufacturers. A well-designed bulb is also important from the standpoint of safety in handling, both during production and during installation. Since the tubes are rigidly inspected for physical flaws and imperfections, it is also advantageous to have the best bulb possible to reduce the number of rejects during the manufacturing process. These factors become increasingly more important as the size of the bulb is increased.

The present trend toward larger television picture tubes of the highest possible quality makes it necessary to

obtain more and more information as to the strength and behavior of both glass and metal bulbs under the stresses created by the high vacuum in the tubes. Faced with the need for information, methods have been devised to test such tubes mechanically under pressures greater than one atmosphere (approximately 15 psi). Such methods may use either air or liquid (water) pressure systems. Both systems are

Fig. 2. Circuit for implosion monitoring tubes in air pressure tank.



used by Sylvania's Television Picture Tube Division.

Liquid Pressure System

In using the liquid system, a tube enclosed in a screen cage (see Fig. 1) and is lowered into a tank which filled with water at a known temperature. The tank is then sealed off and controlled cushion of air is allowed enter the tank to build up the pressure to any desired value. Due to the incompressibility of water, the pressure is transmitted equally over the whole surface of the tube, and the pressure is built up until the tube is broken at some indicated gage pressure. tube to be tested in this manner must be first abraded (or scratched), using 150 emery grit, around the four sides and corners of the faceplate to simulate any desired degree of abrasion which might be encountered in handling. The water tank setup is quite flexible, requires a minimum of space, and enables rapid testing at a moment's notice.

Occasionally it may be desirable to pressure-check bulbs before they are made into tubes and exhausted. This is done simply by inserting a rubber stopper in the flared end of the neck and subjecting the bulb to pressure as before. The applied pressure in this case (since the bulb contains air at atmospheric pressure and not a vacuum) will be read directly as gage pressure, whereas tubes already exhausted are actually under a pressure of 15 psi due to the vacuum, plus the indicated gage pressure. To eliminate any confusion which might exist when referring to the test results, all pressures are recorded as absolute readings and refer to actual pressures exerted upon the tube or bulb body—whether the tube is under a vacuum or stoppered to air.

This liquid system is very useful for obtaining data quickly to detect physical flaws in bulb construction or defects due to scratches, chips or imperfections in glass quality. Much useful information may be obtained from the remains of the tube by examining the fracture patterns of the glass chips.

Air Pressure System

It may also be of interest to subject bulbs to pressure for longer periods of time to determine glass or metal fatigue effects occurring over a period of days. Any such setup which must run continuously, 24 hours a day for a week or so, must be carefully controlled to pressure. A means must also be devised to monitor the tubes under pressure and indicate their condition. Such a testing system has been set up and is now being used by Sylvania's Television Picture Tube Division General Engineering Department at Seneca Falls.

Consistent and reliable data can be obtained by using the following procedure:

(Continued on page 25)

HIGH-STABILITY ISOLATION AMPLIFIER*

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Design and development of a stable resolver isolation amplifier for precision analog computer applications.

The resolver isolation amplifier to be described here was developed for use with appropriate angle resolvers in airborne analog computer application where a high degree of accuracy and stability is required. Since the most serious errors in such a computer are attributable to high resolver driving source impedance and/or to resolver secondary loading, it is the fundamental purpose of the isolation amplifier to provide a low driving source impedance for the driven resolver together with a high and constant load impedance to the driving resolver.

Because as many as twelve resolver amplifiers may be involved in a computer system, a high order of stability in amplifier transfer characteristics with variations in tube parameters, supply voltages, and environmental conditions is necessary if the required accuracy is to be obtained. It is furthermore very desirable that the inherent stability of the amplifier be substantially better than that of the resolver, so that any variations in the amplifier itself will not impair the over-all accuracy of the system.

Major electrical specifications of the isolation amplifier as dictated by the requirements of the over-all system are given in Table 1.

Because a relatively large number of isolation amplifiers is required in the system, and the space available in the electronic package is very limited, the above specifications must be met with a minimum number of tubes and components. This factor, together with certain environmental requirements peculiar to airborne equipment, has dictated

the basic design features to a major extent.

Basic Design Considerations

Analysis of the foregoing specifications with respect to amplifier gain, gain stability, and terminal impedances indicates that a negative feedback amplifier with a feedback factor of very nearly unity is required. In such an amplifier, the gain stability as a function of variations in internal or loop gain due to changes in supply voltages, tube characteristics, and component values, etc., is related to the nominal loop gain according to the relation given in Eq. (1):

% A_F variation

$$= \left[\left[\frac{A(1-c)}{A_F + (1-c)(A - A_F)} \right] - 1 \right] \times 100 \quad \dots \dots \dots \quad (1)$$

where A = gain without feedback

A_F = gain with feedback = 1.002 nominal

Table 1. Major electrical specifications.

Gain: adjustable from 1.000 to 1.060

Gain stability: $\pm .03\%$ nominal,
 $\pm .05\%$ minimum for all possible operating conditions

Phase shift: $0.0^\circ \pm 5'$

Signal characteristics: input voltage, 0-40 volts r.m.s.; frequency, $900 \pm 10\%$ cps

Distortion: 0.5% maximum total harmonics

Impedance characteristics: load—4950 ohms at 73° ; input— $>500,000$ ohms; output— <15 ohms

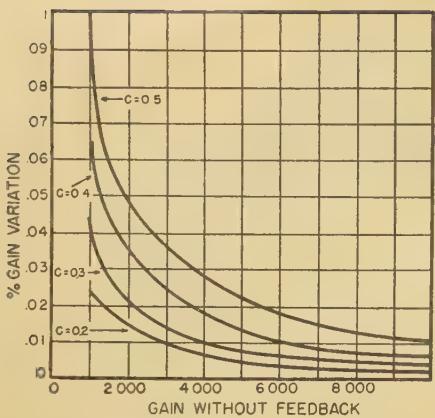


Fig. 1. Per-cent gain variation with feedback vs. gain without feedback.

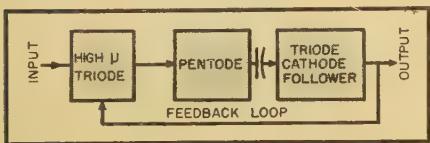


Fig. 2. Block diagram of amplifier.

feedback loop which is d.c.-coupled to the cathode of the triode input stage. The two vertical lines between the second and third blocks do not designate a capacitor in this case, but indicate the point at which the loop is broken for purposes of the following analysis.

In a stage-by-stage analysis of a design incorporating substantially 100% over-all feedback, it is generally necessary to treat each stage as an element of an open-loop system, in order to determine its individual transfer characteristics. The point at which the feedback chain is opened must be so selected that any impedances common to two or more stages remain essentially unmodified; this usually necessitates opening the loop at an appropriate point in the forward signal path. In this discussion, the feedback chain is assumed to be broken between the pentode plate and the cathode follower grid, with the latter taken as the input terminal of a three-terminal network. Gain expressions for the cathode follower, triode, and pentode stages are given in Fig. 4.

In Eqt. (1) of Fig. 4, R_k represents the impedance of the tuned resolver load, which for the particular resolver used is of the order of $7000 + j0$ ohms. The effective Q of the tuned resolver is slightly greater than 0.2, when damped by the equivalent output impedance of the cathode follower. The calculated voltage gain of this stage is 0.88X and the output impedance 167 ohms.

The triode gain stage is subject to cathode degeneration by virtue of the feedback connection, which accounts for the appearance of the term $R_k(1 + \mu)$ in the denominator of Eqt. (3); Fig. 4. R_k in this case represents the output impedance of the cathode follower plus any series impedances in the feedback loop, whereas R_L , R_p , and R_g are the plate load, tube plate resistance, and following stage grid resistor, respectively. Maximizing Eqt. (3) for gain, it will be seen that μ should be as large as possible while R_k should be kept small. At the same time, it can be shown that where a feedback loop is returned to the cathode of the first stage, the sensitivity in over-all gain with feedback to variations in μ of the first tube cannot be made appreciably less than $1/\mu$. Therefore, the amplification factor of the first tube should be large, both from the standpoint of maximum loop gain and best over-all gain stability.

The voltage gain of a pentode amplifier at medium frequencies may be expressed by Eqt. (4) of Fig. 4. Because both R_p and the effective input resistance R_s of the following stage are large compared with the plate load R_L , a voltage gain approaching $200X$ may readily be obtained in a pentode of the 6AK5 class, with a plate resistor of $120K$ ohms. The over-all gain of the system is, of course, the product of the voltage gains of the individual stages, and under open-loop conditions measures $4170X$ from the grid of the cathode follower to the plate of the pentode gain stage.

Circuit Features

Turning now to the design features of the individual stages, Fig. 3A shows

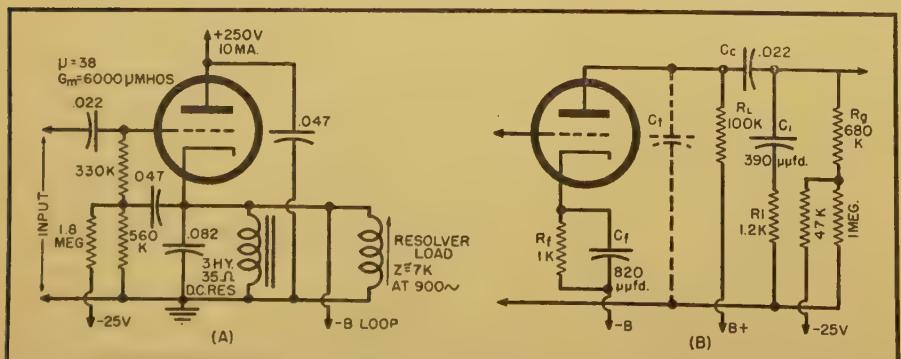
the cathode follower and its associated resolver load. This stage has a number of features of interest. The output cathode follower tube must be capable of passing a quiescent d.c. plate current somewhat greater than the peak dynamic current represented by the required peak output voltage divided by the load impedance. When working into a predominantly inductive load, negative peak clipping sets in appreciably before the instantaneous plate current reaches zero, due to an elliptical load line; thus the quiescent plate current may need to be even higher than the above calculations indicate. This condition may be compensated to some extent by resonant tuning of the inductive load circuit, in which case the latter is treated as a substantially pure resistance. Nevertheless, for large output voltages, the choice of a tube type for the cathode follower stage is governed primarily by plate dissipation considerations. A tube having a plate dissipation rating of 2.7 watts and characteristics similar to one section of type 12AV7 is well-suited to the application; using the triode section of type 6U8 triode-pentode, it is possible to develop up to 55 volts r.m.s. across the load before negative peak distortion becomes apparent. This is well above the specified value of 40 volts.

Because undesirable reaction torque effects occur when appreciable d.c. passed through the resolver static winding, means must be provided for maintaining the residual current below 2.0 ma. The cathode circuit of the output tube is returned to ground through a choke having a d.c. resistance one-tenth or less than that of the resolver static winding and an inductance of about two to three times the latter. The resolver and choke inductances are lumped together and treated as the effective inductance of the tuned load circuit.

A fixed grid bias of -5.5 volts is supplied to the cathode follower through a voltage divider from the -volt supply. Because of possible gas current difficulties in a triode operating at a sustained high plate dissipation, the d.c. resistance in the grid circuit is kept relatively small. To reduce plate circuit loading on the preceding stage, a form of capacitive feedback from cathode-to-grid return is incorporated, whereby the apparent input resistance of the cathode follower is as much as nine times the value of the grid resistor. This provides a 10-15% increase in effective gain of the pentode stage. The measured voltage gain of the cathode follower at 900 cycles—when working into a tuned resolver load of $0.88X$, and the open-loop output impedance is 190 ohms.

The triode input stage is subject to cathode degeneration by virtue of

Fig. 3. (A) Schematic diagram of cathode follower and associated load. (B) Phase-compensating elements R_1 and C_1 inserted in the triode stage.



dances associated with the feed-loop. Hence, the cathode follower output impedance, the equivalent impedance of the resolver load, and any impedances in the feedback loop must be taken into account in calculation of the transfer characteristics of the stage. The cathode follower output impedance is very much smaller than dynamic impedance of the tuned circuit in parallel with it; hence at resonance the latter can be neglected. Effective impedance in the cathode stage of the triode is, to a close approximation, the cathode follower output impedance in series with the back resistor, and it is substantially true.

The values of triode stage plate load resistor, coupling capacitor, and following stage grid resistor were selected on the basis of conventional resistance-coupled amplifier practice. Preliminary choice of feedback resistor was based on bias requirements. The tube used is section of a type 12AX7 having rated μ of 100 and rated R_p of 62,500 ohms. Calculated voltage gain was 28X at a 100K plate load, while the measured gain is 25X.

Design of the pentode stage is straightforward in that selection of component values was made on the basis of maximum stage gain consistent with phase requirements. The tube used is the equivalent of the 6AK5 pentode, having a rated G_m of 5100 mhos and approximate R_p of 0.5 megohms. By reference to the characteristics of this type, it was determined that optimum gain in resistance-coupled applications could be obtained when $E_b = 3E_{bb}$; and having selected a suitable value of plate load resistance, the control grid and screen potentials were set accordingly. To eliminate the need for a large electrolytic capacitor for plate bypassing, the cathode is grounded, and a fixed bias of -1.2 volts is applied to the grid through a shunt across the -25 volt supply.

In resistance-coupled applications where the load resistor is relatively low, the published tube G_m and R_p

values do not give a true representation of the stage gain to be expected. The effective G_m generally ranges from 0.3 to 0.4 of the rated value, while the rated R_p is multiplied by roughly the reciprocal of this factor. Applying these corrections, the calculated voltage gain of the pentode stage was 205X and the measured gain is 190X.

Use of multisection tubes in the overall design permits assembly of a two-channel isolation amplifier with but three tube envelopes, a decided saving in space. Each channel utilizes one-half of a 12AX7 dual high-mu triode for the input stage, followed by a 6U8 pentode section, coupled in turn to the 6U8 triode section as the output cathode follower. Gain control is accomplished by means of a high resistance potentiometer in the cathode circuit of the triode stage for each channel; this control shunts the feedback loop, allowing variation of the gain with feedback from 1.001 to 1.060. Gain and phase shift measurements were conducted on each channel of the complete amplifier by opening the feedback loop between the pentode and cathode follower stages, applying the input signal to the grid of the latter, and measuring the output at the pentode plate. The input triode grid was grounded during these tests. A curve showing over-all amplitude and phase characteristics as a function of frequency is shown in Fig. 5A. It should be noted that no phase compensation has been incorporated into the design at this point.

The Stability Problem

Stability against oscillation in a feedback amplifier requires that the gain within the feedback loop be less than unity at frequencies where the total phase shift around the loop becomes 180°—the Nyquist criterion. The difficulty in realizing this condition depends both upon the loop gain and upon the total number of phase shifts within the loop, since the maximum phase shift in any one network cannot ordinarily exceed 90°. The procedure generally adopted in stabilizing a closed-loop

$$A \text{ (cathode follower, } R_b = 7000 \text{ ohms)} = \frac{\mu R_k}{R_p + R_k (\mu + 1)} = 0.88 \times . \quad (1)$$

$$Z_0 \text{ (Cathode follower)} = \frac{R_p}{\mu + 1} \approx \frac{1}{G_m} = 167 \text{ ohms} . \quad (2)$$

$$A \text{ (triode)} = \frac{\mu \left[\frac{R_L R_g}{R_L + R_g} \right]}{R_p + \left[\frac{R_L R_g}{R_L + R_g} \right] + R_k (\mu + 1)} = 25 \times . \quad (3)$$

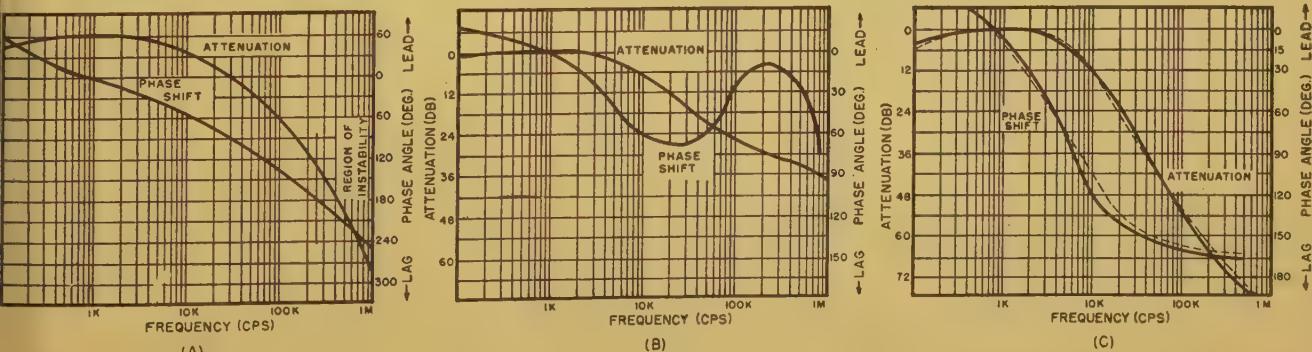
$$A \text{ (pentode)} = G_m \left[\frac{1}{R_L} + \frac{1}{R_p} + \frac{1}{R_g} \right] = 190 \times . \quad (4)$$

Fig. 4. Gain expressions for cathode follower, pentode, and triode stages.

system revolves around controlling the transmission characteristics around the loop at frequencies where phase shifts become important, in this case the region above about 200 kc. The curves of Fig. 5A show that, with a total voltage amplification at medium frequencies exceeding 72 db, the loop gain is appreciably greater than unity at 245 kc, where the loop phase shifts total 180°. High frequency oscillation was accordingly experienced, and appropriate phase compensation became necessary.

The major sources of high frequency phase shift are the shunting capacitances associated with the two interstage coupling networks and the characteristics of the resonant resolver load. The latter contributes virtually a 90° phase lag above about 85 kc., and cannot in itself be compensated. The interstage networks also contribute phase lags, each of which is asymptotic to 90° at frequencies of the order of 900 kc. In order to satisfy the criterion for stability with a loop gain of 72 db, it is necessary to achieve an attenuation slope approaching the critical 12 db per octave while still maintaining an adequate margin of safety. With a slope of

Fig. 5. (A) Over-all amplitude and phase characteristics with no phase compensation. (B) Attenuation and phase characteristics of first stage with phase compensation. (C) Attenuation and phase characteristics of final amplifier.



Loop gain: 4170X in voltage
 Phase margin: 13°
 Input impedance: 980,000 ohms
 Output impedance: <0.2 ohms
 Phase shift at 900 cps: <.08°
 Over-all gain: 1.001 minimum;
 1.060 maximum
 Gain stability with 50% change
 in loop gain: .022% at gain
 1.001X; .027% at gain
 1.060X
 Maximum undistorted output voltage: 55 volts, r.m.s.
 Total distortion at 40 volts, r.m.s.: <.05%
 Linearity, 1-40 volt input: ±.020% maximum deviation
 Interchannel crosstalk: -58 db below full output

Table 2. Major performance characteristics of each channel of a two-channel prototype isolation amplifier.

10 db per octave, the rolloff must commence seven or more octaves below the critical frequency of 245 kc., or at approximately 1900 cps. To assure reasonable phase margin, a somewhat lower cutoff frequency is desirable. Accordingly, a capacitor is shunted across the equivalent parallel resistance of the first interstage, of such value as to produce a central or -3 db frequency of 5500 cps with an accompanying phase lag of 45°. A small resistor is placed in series with this capacitor in order to control the phase characteristics at frequencies above about 100 kc. This is

shown in Fig. 3B. C_1 and R_1 are the phase-compensating elements, R_0 is the equivalent parallel resistance, and C_0 the shunt capacitances associated with the interstage. The value of C_1 is chosen to provide the required attenuation characteristics as mentioned above. The network $C_1 R_1$ itself possesses an inverse tangent phase characteristic defined by the expression:

$$\varphi_1 = -\tan^{-1} \frac{1}{\omega C_1 R_1} \dots \dots \dots (2)$$

while the interstage, $C_0 R_0$, has the normal tangent phase characteristic:

$$\varphi_2 = -\tan^{-1} \omega C_0 R_0 \dots \dots \dots (3)$$

$$\text{where } C_0 = C_1 + C_2$$

$$R_0 = \frac{R_p R_1}{R_p + R_1}$$

The net phase shift is the sum of the two tangent curves defined above; it exhibits a reduced phase lag characteristic which tends to return to zero phase shift between certain limiting frequencies determined by the central frequencies of $R_0 C_0$ and $R_1 C_1$. At the same time, the attenuation characteristic is now determined by $C_1 + C_2$ rather than by C_1 alone, and it is asymptotic to 6 db per octave above the cutoff frequency of 5500 cps. When this is added to the second interstage and the resolver load circuits, the required attenuation slope of 10 db per octave will be obtained. The attenuation and phase characteristics for the first interstage with phase compensation are shown in Fig. 5B.

When the phase correction techniques

described above were applied, the amplifier was stable at a loop gain of 7 db (voltage gain $\approx 4200X$), with an equivalent amount of active feedback. However, the calculated phase margin was only of the order of 6°, which was considered inadequate for production tolerances. Supplementary phase correction can be provided by introducing a leading phase shift in the cathode circuit of the first stage. This is accomplished by means of a small capacitor shunting the feedback resistor.

The effective output resistance R_o of a triode with cathode degeneration, where the cathode impedance R_k is non-reactive, may be expressed by:

$$R_o = R_p + R_k (1 + \mu) \dots \dots \dots$$

and is purely resistive, neglecting tube capacitances. If R_k is incompletely bypassed with a small capacitor, the second term in Eq. (4) becomes:

$$\frac{(1 + \mu) R_k}{R_k - \frac{j}{\omega C_k}} \dots \dots \dots (4)$$

and R_o becomes complex. The resulting phase angle is:

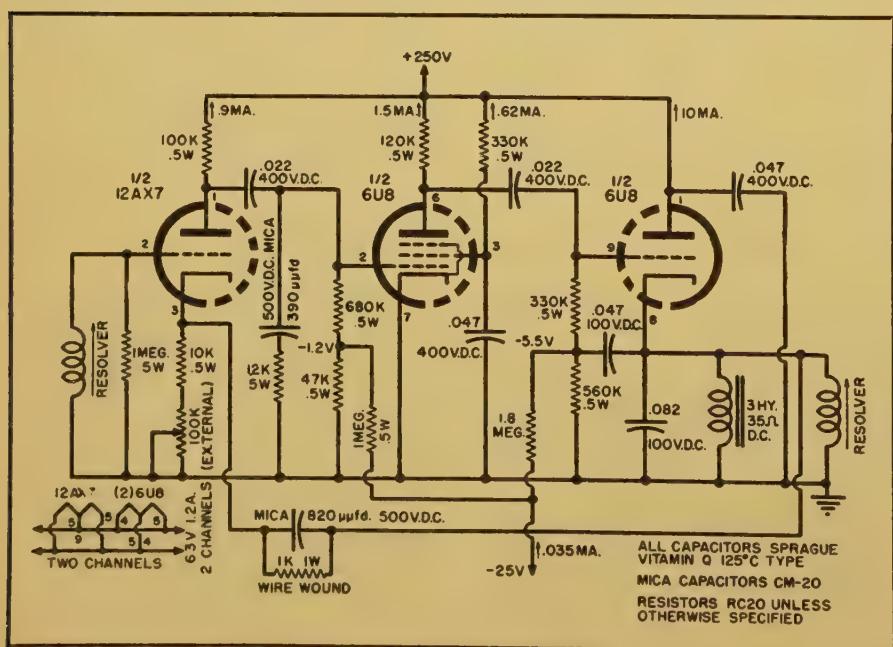
$$\varphi_3 = \tan^{-1} \omega C_k R_k (1 + \mu) \times \left[\frac{R_k}{R_p + R_k (1 + \mu) + R_L} \right] \dots \dots \dots$$

and constitutes a high-frequency leading phase angle in the a.c. cathode current. The net effect is to attribute a small leading phase shift to the constant-voltage source, which tends to compensate to a certain extent the overall high-frequency phase lag around the feedback loop. The resulting additional phase lead of about 10° at 100 kc. is sufficient to eliminate any tendency toward oscillation at high signal levels. The final amplitude-phase characteristics of the complete amplifier (one channel) are shown in Fig. 5C. Calculated and measured data are included for purposes of comparison.

Figure 6 shows a complete schematic diagram of one channel of the resolver isolation amplifier, including component values, tolerances, and operating conditions. The major performance characteristics of a two-channel prototype unit are given in Table 2.

Conclusion

This article has dealt with the theoretical and experimental procedures employed in the development of a high-stability resolver isolation amplifier. As can be seen from Table 2, the unit meets the specifications of Table 1 with adequate leeway for tube changes, varying of components, and other normal shifts in the operating characteristics of the electronic components involved. Over-all performance of the completed amplifier is excellent.



TUNED MICROWAVE REFLECTORS

By SAMUEL FREEDMAN

Sightmaster of California Co.

THE common concept that the reflection of a microwave signal from a reflector is comparable to the reflection of a beam of light from a mirror is faulty. It fails to take into account the fact that at microwave frequencies the wavelength is only a few times greater than the reflector dimensions, whereas the dimensions of a mirror may be millions of times greater than the wavelength of light. If a radar reflector, for example, is 75 cm. in diameter, it would only be $7\frac{1}{2}$ times greater in dimension than the wavelength of a 10-cm. (3000 mc.) signal. A mirror of the same size would have a diameter 1,250,000 times greater than the mean wavelength of visible light.

This difference was believed by the author to be a contributing cause of the fact that—in submarine radar tests targets dead ahead could also be detected in back of the reflector and at "blind" angles. It was also felt to be a contributing cause of the variation of performances with differently adjusted horns and various installations.

It was found that reflectors should be tuned for the wavelength of operation rather than have random dimensions with respect to some fractional part of a number of whole wavelengths. This fractional wavelength excess can cause standing waves to exist between the boundaries of a reflector, thereby degrading performance. Steps were taken to solve—both physically and mathematically—the problem of boundary conditions that exists when a reflecting plane is of finite dimensions. These efforts resulted in tuned microwave reflectors which focus, defocus and beam radio signals through space at microwave frequencies with an efficiency equivalent to that of an infinite plane.

Work on these microwave reflectors was originally started in 1944 by the author, then Lieutenant Commander in the U. S. Navy Submarine Service, and Gustavo Fonda Bonardi, then a Lieutenant in the Royal Italian Navy Submarine Service, at New London, Conn. The first working model was built by the author early in 1945 and tested

on an SJ radar on the roof of the U. S. Coast Guard Electronic Technicians School at Groton, Conn., where excellent radar targets were picked up on seagoing craft operating in Long Island Sound. A patent was granted on December 16, 1952, after continuous prosecution by the U. S. Office of Naval Research from the time it was filed, May 9, 1945. Originally classified Secret, this patent has since been declassified and the commercial rights to its exploitation given to the inventors who are now back in civil life.

A tuned microwave reflector is able to achieve an efficiency equivalent to that of an infinite plane because it differs from the usual type of reflector in that it is provided with phase-shifting ends. The ends tend to annul the standing waves on the reflector and avoid undesired radiation proceeding therefrom. These phase-shifting ends improve the efficiency of any kind of surface reflector. For horizontally polarized waves, a flat reflector need only have phase-shifting ends; for vertically polarized waves, vertical wings are added to the edges. The ends and wings are tuned (made dimensionally correct) for the frequency employed and the angle of reflection desired.

This "tuning" process may be better understood by referring to Fig. 1A which illustrates an optical reflection rather than a radio reflection. *S* represents the source of energy, *A* represents the receiver or antenna, *C* is the plane of the reflector, *B* is the point at which the power from *S* strikes the reflector, *a* is the useful area of the receiver, *b* is the area of the reflector of finite dimensions in the reflecting plane *C*, *S'* is an imaginary source of energy situated on the other side of the reflector and symmetrical to the real source *S*, θ is the angle of incidence, r_1 is the distance from the source to the point of reflection *B*, and r_2 is the distance from the point of reflection *B* to the receiver *A*.

Assuming that r_1 is the distance between a radar detecting station and a target and that r_2 is the same distance back (say, 10 miles each way), the fol-



Typical microwave relay tower.

The efficiency of passive microwave reflectors can be increased by "tuning".

lowing differences will exist between finite and infinite reflector conditions:

$$\text{Finite Case: } \frac{k}{(4\pi r_1 r_2)^2} = \frac{k}{1.577 \times 10^6}$$

$$\text{Infinite Case: } \frac{k'}{4\pi(r_1 + r_2)^2} = \frac{k'}{5024}$$

Since k has been mathematically found never to be greater than k' , the ratio of efficiency favors the infinite case.

For communication situations where the outgoing signal proceeds onward rather than returning to the source, the distances represented by r_1 and r_2 would normally differ. Assuming that the distance from the transmitting source to the reflector r_1 is 10 miles and the distance from the reflector to the receiving point or a subsequent reflector r_2 is 20 miles, the following would apply:

$$\text{Finite Case: } \frac{k}{(12.56 \times 10 \times 20)^2} = \frac{k}{6.31 \times 10^6}$$

$$\text{Infinite Case: } \frac{k'}{12.56(10 + 20)^2} = \frac{k'}{11,304}$$

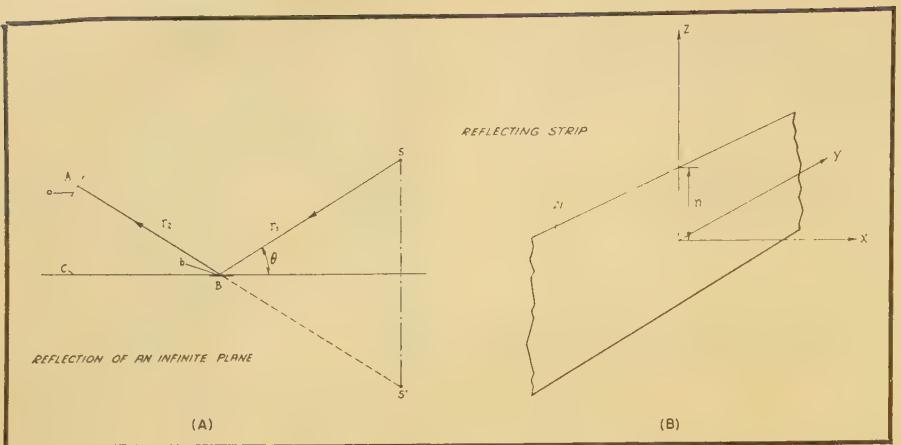


Fig. 1. (A) The reflection of a plane wave from an infinite reflecting surface. (B) Fragmentary section of a flat reflecting strip shown in Cartesian coordinates.

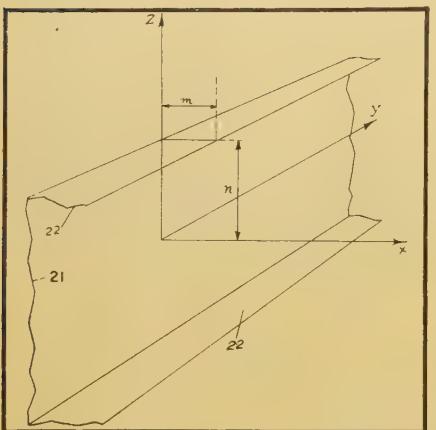


Fig. 2. Section of wing-type reflecting strip for vertically polarized field.

Here the ratio of efficiency in favor of the infinite case becomes approximately 6,310,000 divided by 11304, or 486.4 times.

It can therefore be stated that in the finite case the power falls off inversely as the square of the product of r_1 and r_2 , whereas in the infinite case the power falls off only as the square

of the sum (not the product) of r_1 and r_2 . This important difference in efficiency results from the fact that in the finite case the arriving plane wave system is absorbed and scattered to become a new spherical system which propagates in all directions. In the infinite case, however, the arriving plane wave system still remains a plane wave system after reflection, propagating in a direction symmetrical to that of the arriving system (Fig. 1A).

A plane system of electromagnetic waves does not change its plane characteristics if at any point in space Maxwell's equations can be satisfied by the equations of a plane wave propagation, both for the electric field and for the magnetic field. Maxwell's equations provide some kind of equilibrium between the electric field and the change in the magnetic field at every point in space, and they provide a similar balance between the magnetic field and the change in the electric field. Whether this change results in a displacement current or in a conduction current is inconsequential.

In the case of an abrupt change in the means of propagation, such as the

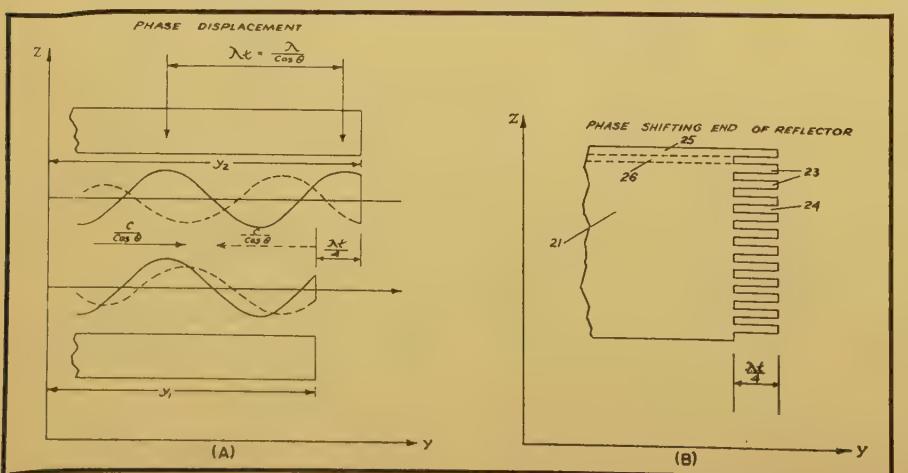
presence of a conducting surface, it is necessary to replace the displacement current in the space beyond the conducting surface by the actual conduction current in the surface in order to maintain the balance with the magnetic field at the surface. In the case of a single arriving system of energy, balance can be maintained only by additional presence of a reflected system, so that the resulting field will be balanced by the current set up by the first system in the conducting surface. If this conducting surface has to replace a plane system, the currents which circulate in it must be such as to balance the field resulting from the simultaneous presence of an arriving plane wave system and a reflected system. This balance can be accomplished by proper choice of reflector shape.

A field polarized in the plane containing the source and the center of the reflector requires a flat sheet, as in Fig. 1B, wherein 21 represents a fragmentary section of a flat reflecting sheet having a width of $2n$ and being in the $Y-Z$ plane. A field polarized perpendicular to that plane requires addition of two wings of definite width to the same flat sheet, as in Fig. 2, wherein the reflecting sheet 21 is provided with a wing 22 of a width m up to each edge. The wings 22 are shown parallel to the $X-Y$ plane while the reflecting sheet 21 is in the $Y-Z$ plane, i.e., the wings 22 are perpendicular to the reflecting sheet 21.

In both cases, the nearest end of the reflecting sheet 21 and the opposite end should be cut in a series of projecting strips 23 of a definite length, as shown in Figs. 3B and 5, in order to insure proper distribution of currents near the end of the conducting surface. Fig. 3B shows a fragmentary end section of a flat reflecting sheet 21 having a series of projecting strips 23 extending from the end. The space 24 between the strips is of the same width as the strips. These projecting strips may be considered as being merely extensions of imaginary strips 25, indicated by dotted lines extending the complete length of the reflector. The adjacent portions 26 of the reflector may be considered as being similar strips of shorter length. Each strip 25 and adjacent strip 26 form a so-called phase-shifting couple, the purpose of which is more fully explained below. The reflector is composed of one or more of these phase-shifting couples.

In the case of the wing reflector, each projecting strip 23 must carry its own wings of the same width as the main wings 22 (Figs. 5A and 5B). Fig. 5A shows a fragmentary section of the arrangement of the wing type reflector, wherein 21 is a flat reflecting sheet having projecting strips 23 extending from

Fig. 3. (A) Phase displacement resulting from difference in length of two reflector strips. (B) Section of reflector showing phase-shifting end used for tuning.



ends, as in Fig. 3B. This reflector so has wings 22 perpendicular to each outer edge, as in Fig. 2, and in addition has wings 27 of the same width as the wings 22 upon each of the side edges of the projecting strips. Figure 5B shows another arrangement of the wing type reflector which is identical to that

Fig. 5A with the exception of the closed ends on the strips 23. Closures 24 are provided on the outer ends of the strips between the wings, and closures 29 are provided at the inner ends. The length of the projecting end strips 23

$$= \text{wavelength along the reflector}$$

$$= \frac{4}{4 \cos \theta}$$

$$= \text{wavelength in free space}$$

$$4 \cos \theta$$

and the width of the wings 22

$$= \text{wavelength in free space}$$

$$4 \sin \theta$$

here θ is the reflection angle.

The phase displacement resulting in a length difference in the projecting strip between two strips 26 is shown in Fig. 3A. The direct wave is shown by a full line and the reflected wave by a dotted line. It may be seen that the reflected waves are 180° out of phase on the two strips. Their fields thus destroy each other so that the total effect is a lack of back radiation. A reflector may comprise a number of such strips where each pair, in turn, comprises an elementary or unit reflector—the narrower the strips, the better the result.

The strips which form the phase-shifting ends and the wings must be designed both for frequency and direction. Change of frequency or direction affects the efficiency of the reflector as plotted in Figs. 4A and 4B. Figure 4A is a polar diagram showing the change of reflected power and percentage of efficiency vs. change of direction for a series of stated frequencies. Figure 4B is a Cartesian diagram showing the change of reflected power and percentage of efficiency vs. the change of frequency for a series of stated directions. The symbol ω_0 in Fig. 4 represents the cutoff frequency of the reflector. The cutoff frequency is that which has the maximum power reflection at zero reflection angle, beyond which reflection no longer occurs. It is the lowest frequency that the reflector is able to reflect with maximum efficiency. The cutoff wavelength will be four times longer than the strips which comprise the phase-shifting ends if the reflection angle is equal to zero. The reflection pattern for a stated reflector therefore depends upon the length of the phase-shifting ends, which determines the cutoff frequency. By using Fig. 4A, it is possible to determine how the reflection efficiency changes with a change of reflection angle for stated frequencies greater than the cutoff frequency. This

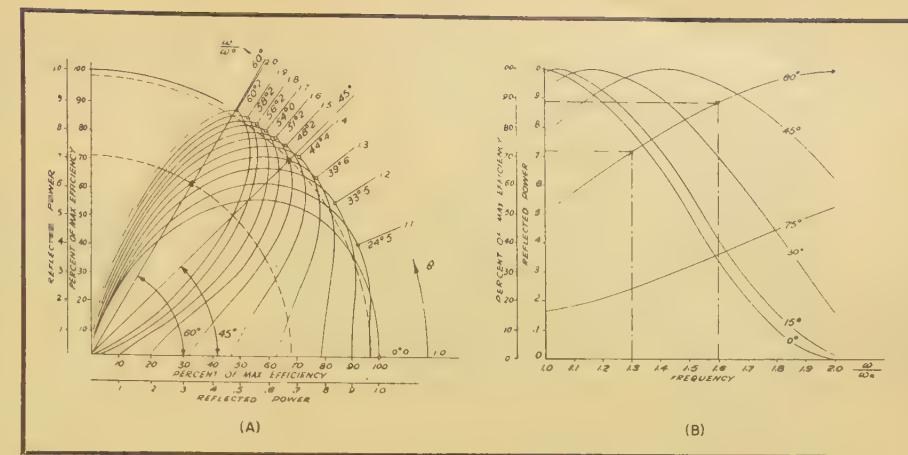


Fig. 4. (A) Reflector polar diagram showing reflected power and % efficiency vs. change of direction for various frequencies. (B) Cartesian diagram showing reflected power and % efficiency vs. change of frequency for various directions.

is done by finding the intersection of the curve identified by the desired frequency, with a line drawn from the left corner (center of the polar diagram), and making the desired angle with the abscissa. The length of the radius from the center to this point, transferred on either side of the graph, indicates the percentage of efficiency directly. The best reflection angle for every frequency is written under the line which departs from the most external point of every curve.

Assuming that the desired reflection angle is 45° and that a frequency 1.3 times the cutoff frequency is used, a line is then drawn from the left corner which makes an angle of 45° with the abscissa. The intersection of this line with the curve labeled 1.3 is then marked. Using the length of the line from the center to this point as a radius, an arc is laid off on the chart. The efficiency is found to be approximately 97% for 45° . If a reflection angle of 60° and the same frequency (1.3 times cutoff value) are used, the

(Continued on page 27)

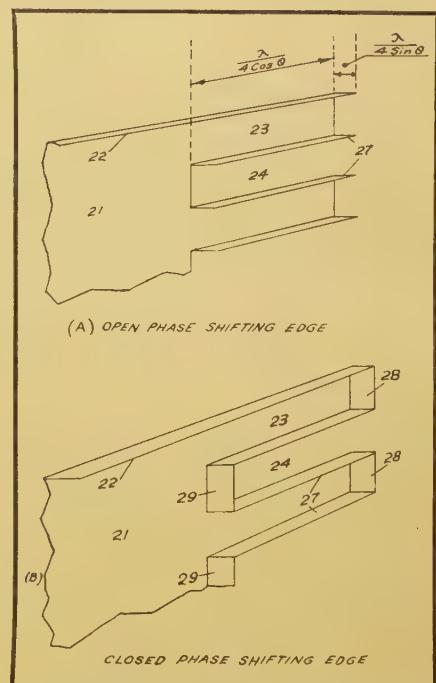
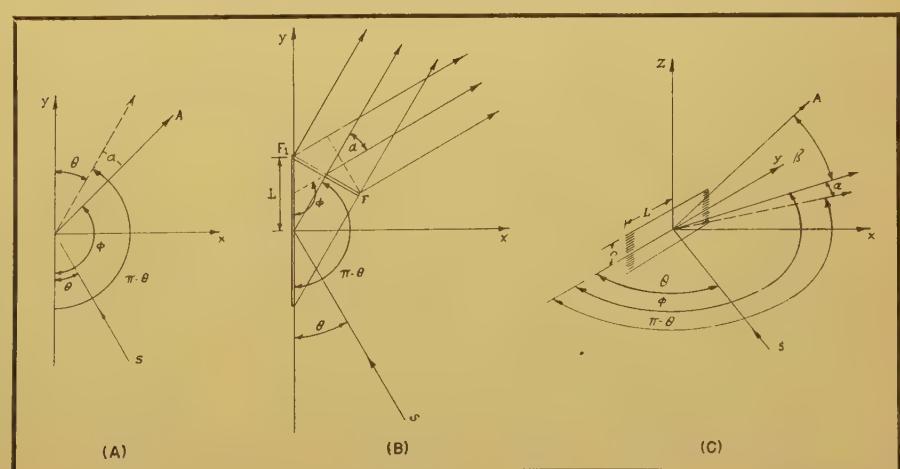


Fig. 5. Sketches showing modifications of the phase-shifting ends.

Fig. 6. (A) Diagram indicating lack of symmetry when antenna is moved with respect to reflector and source. (B) Diffraction effects for position illustrated in (A). (C) Diagram portraying unsymmetrical condition when antenna moves out of X-Y plane.



REMOTE TEMPERATURE

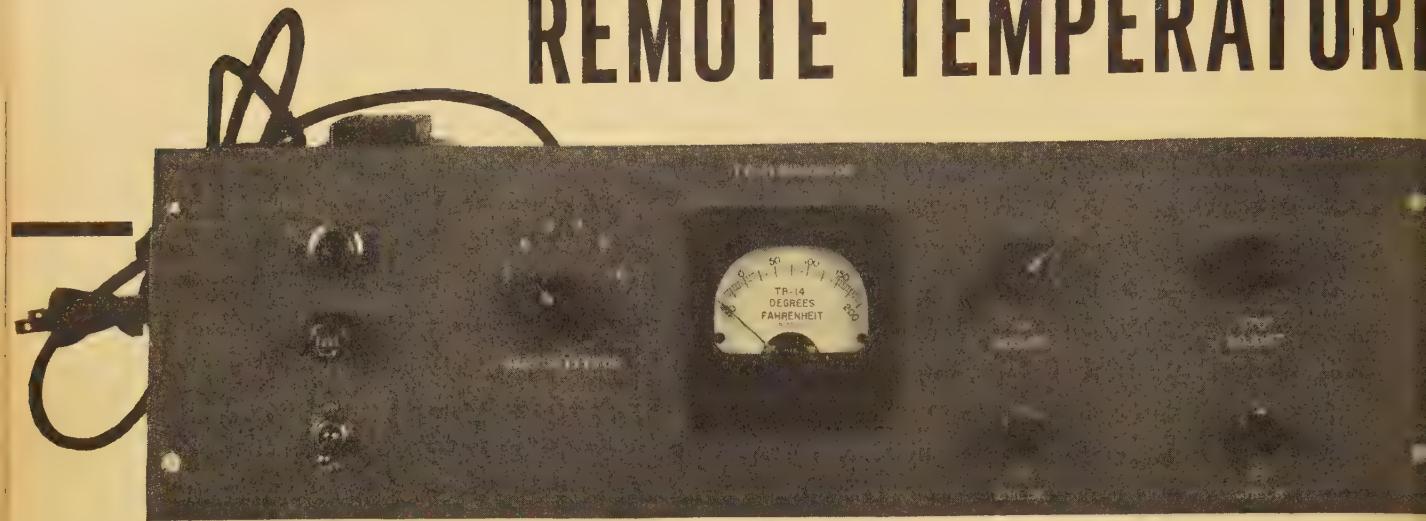


Fig. 1. Front panel view of the direct-reading temperature indicator. Meter is calibrated in ° F.

THE EQUIPMENT to be described here was developed to measure temperatures between -50°F and $+200^{\circ}\text{F}$ inside of electronic "packages" within a guided missile during preflight tests. Temperatures in such "packages" must not be allowed to rise above $+150^{\circ}\text{F}$ because of the possible failure of such components as electrolytic condensers, and the presence of a remote-reading "thermometer" is a good check on the efficiency of the cooling system that is built into each missile.

One type of remote-reading temperature-sensitive gage is the well-known thermocouple. It is a junction of two dissimilar metals which generates a voltage proportional to the temperature of the junction. This voltage is a matter of a few millivolts and must be indicated on a sensitive indicator. The junction is frequently installed by drilling a hole in the structure, inserting the thermocouple junction, and peening the surrounding metal so as to hold the

junction firmly. The indicator will indicate (in millivolts) the temperature of the structure; a conversion chart for the particular junction used (such as iron and constantan) will give the temperature accurately. The leads from thermocouple to instrument must be of the same metals as those used in the junction.

For this particular application, it was desirable to use a gage of some kind that could be cemented to a thin metal or plastic section or that could be held in an air space. Such a gage is manufactured by the Baldwin-Lima-Hamilton Corporation and is called the TB-14 gage (see Fig. 4). Closely resembling that company's SR-4 strain gages in appearance, the TB-14 utilizes a gage wire whose resistance varies rapidly with temperature, whereas in strain gages the aim is to have constant resistance over a wide temperature range. Another gage, the T-14, is similar in appearance to the TB-14,

but is slightly less expensive and may not be used at such high temperatures.

For best results, the operator should use standard strain gage installation techniques of cementing and moisture proofing. To measure surface temperature, the gage should be cemented to the surface and covered with a layer of felt so that the gage resistance will not be affected by drafts. To measure air temperatures, one edge of the gage should be cemented to any convenient structure, and as much of the gage as possible should be exposed to the air.

Baldwin-Lima-Hamilton also makes gages for sensing temperatures under more rugged environmental conditions such as in corrosive liquids. These gages are protected by stainless steel jackets and can be permanently mounted in the walls of pressurized vessels.

The resistance of the T-14 and TB-14 gages varies with temperature according to the following formula:

$$dR = R_{70} (at + bt^2)$$

where:

dR = change in resistance above R_{70}
 R_{70} = resistance at 70°F

(nominally 200 ohms)

t = temperature rise above 70°F

a = 2.41×10^{-3}

b = 1.92×10^{-6}

This formula gives good accuracy over the range of 0 to $+350^{\circ}\text{F}$. The man-

Fig. 2. Circuit diagram and parts values for the temperature indicator.

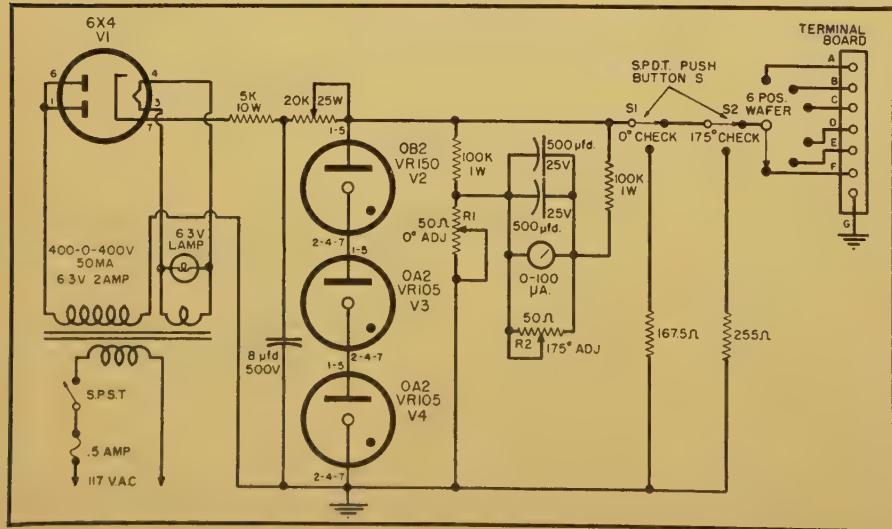
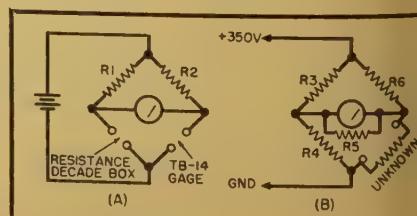


Fig. 3. (A) Conventional Wheatstone bridge for measuring gage resistance
(B) Equivalent circuit of the instrument which is diagrammed in Fig. 2



MEASUREMENT

WAYNE TUSTIN

direct-reading Wheatstone bridge arrangement
indicates temperature of a resistance-wire gage.

turer provides the value of R_{10} for individual gage. A manufacturer tolerance of ± 4 ohms or $\pm 2\%$ is retained.

To determine the temperature, using type gage, the operator must measure the gage resistance. This can be measured by means of a Wheatstone gage as shown in Fig. 3A. If R_1 and R_2 are equal, and if the decade box is continuously adjusted so as to keep the meter at zero, the value of the decade resistance and the value of resistance of TB-14 gage will be equal; and division by means of the table enclosed in each gage will yield the value of temperature.

The system shown in Fig. 3A was initially used for a time in the original field missile installation. A six-position selector switch allowed one instrument to be used with six different gages, mounted in a different part of the missile.

Since this method is obviously cumbersome, due to the need for continuous balancing and reference to charts, the durability of a system that would enable the operator to check temperature every five seconds, and to know temperature without looking at a chart, led to the development of a direct-reading version of the Wheatstone gage. This direct-reading instrument shown in Figs. 1, 5 and 6. It is built

on a standard rack panel, $5\frac{1}{4}'' \times 19''$.

The schematic circuit is shown in Fig. 2, while Fig. 3B depicts an equivalent circuit. Less than 1 volt exists across the gage leads. A six-position selector switch is again provided to enable the operator to check temperatures at six locations.

The gages are installed in the electronic "packages" during manufacture. The gage voltages come out of the packages and eventually out of the missile ground test connectors in the same connectors and cables as other voltages. Ordinary copper leads are used. Since lead resistance is read by the instrument, these leads should be quite large if a long cable is necessary. If the readings were taken 100 feet from the gage, and if 200 feet of #20 wire were used, the error would be $+2.1$ ohms, or $+4^\circ$ at room temperature. Use of #14 wire would reduce the error to less than 1° .

Prior to operation, the instrument should be allowed to warm up for a minute. The gage selector switch position desired for the previously installed gage is then selected. The meter will read some value between zero and full scale. S_1 should be pressed and R_1 adjusted so that the pointer rests at 0° . This replaces the TB-14 gage with a precision resistor of 167.5 ohms, which is the gage resistance at 0° . S_2 should

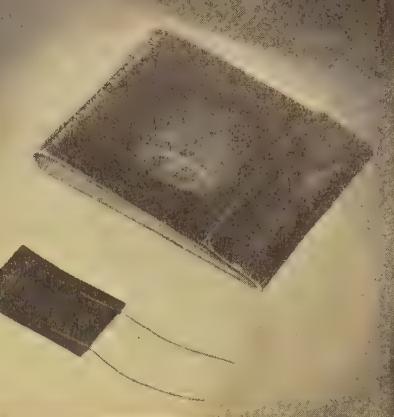


Fig. 4. Gage shown with a book of matches.

then be pressed and R_2 adjusted so that the pointer is at 175° . This replaces the gage with 255.0 ohms, the gage resistance at 175° . These adjustments should be repeated twice before the instrument is actually used; they need be checked no oftener than once per hour.

With this system, an accuracy of $\pm 5\%$ or $\pm 5^\circ$ is achieved at midscale, sufficient for the application. Six gages can be read in ten seconds; the speed with which temperatures may be read has caused this method of measurement to be widely used. During guided missile manufacture, one of the units described above is installed at each missile test position.



Table 1. Calibration of a typical gage based on the formula given in the text.

Temperature (° F)	Resistance (ohms)
-50	144
0	167
50	191
70	200
100	215
150	241
200	268
250	298
300	324
350	364
400	400
450	440
500	484
550	531

Fig. 5. Top view of the temperature indicator.



Fig. 6. Underchassis view of the complete unit.



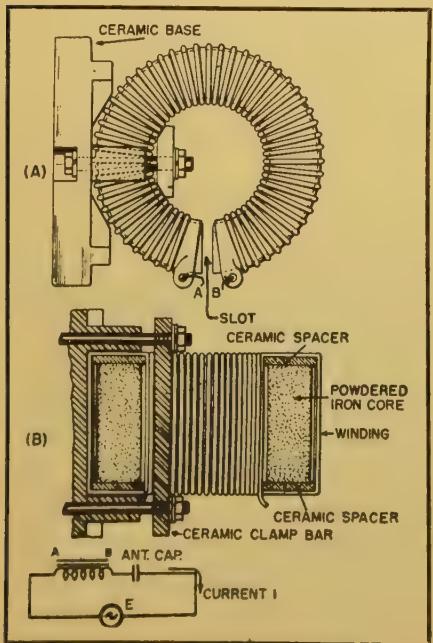
HIGH Q TOROIDAL INDUCTANCE

By SIDNEY WALD

A Q of 600 in the 500-3000 kc. range has been achieved in this antenna loading coil design.

THE high performance toroidal coil described in this article has a number of outstanding technical properties which should help solve many of the problems confronting designers of electronic circuits operating in the frequency range of 500-3000 kc. With an inductance of about 40 μ hy., the coil has a *Q* of over 600 at 1 mc. and a distributed capacity of only about 5 μ ufd. When it is further described as being in the form of a small cylinder having an outside diameter of only 2" and a length of 1", with negligible external field, a large number of applications may suggest themselves.

Fig. 1. The high Q r.f. toroid.



This coil was first developed for a requirement that called for an antenna series-loading inductance as part of a 50-watt airborne communications transmitter. At the lowest frequency for which the equipment was designed, the short antenna into which the transmitter was to operate had a radiation resistance somewhere in the vicinity of 2 ohms, with a capacitive reactance of about 500 ohms. Tuning such an antenna to series resonance by means of a loading coil would result in a current of 5 amperes r.m.s. unmodulated and a peak carrier voltage of 3500 volts across both the loading coil terminals and the antenna-ground terminals. For 100% modulation this voltage would be doubled, thus presenting a most formidable problem in coil design.

The large antenna current obtained under these circumstances necessitates reduction of all series antenna tuning resistances to the absolute minimum if a substantial portion of the available transmitter power is to be delivered to the antenna. Thus, with a loading coil *Q* of at least 500 (equivalent to a series resistance of one ohm), the power in the antenna would be at least double that lost in the tuning circuit. Starting with 50 watts, 17 watts would be lost and approximately 33 watts radiated.

Conventional helical inductances were considered and almost immediately discarded because of the lack of space in the small pressurized antenna tuning compartment of the transmitter. Such crowding would not only have lowered the *Q* disastrously but would also have considerably aggravated the problem of insulating the coil for the 7000 volts developed at series resonance.

The toroidal form of inductance suggested itself at once as the ideal solution provided the necessary low losses, required inductance, and ability to withstand severe heating and large r.f. currents could be achieved in compact form.

Figures 1A and 1B show the component. The coil is wound on a cylindrical shell of powdered carbonyl iron obtained from *Henry L. Crowley & Inc.*, of West Orange, N.J.—their T-D-1 SS.

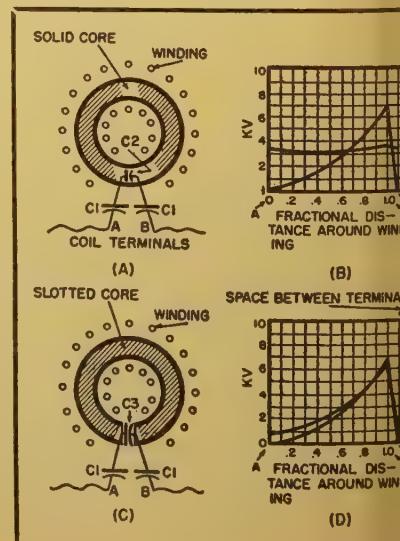
Dimensions of the core are: O.D.—I.D.—1 $\frac{1}{4}$ ", length—1". A $\frac{1}{8}$ " slot is through and two steatite or Mycale caps cemented on either side of the slot with Insl-X. #85 or #95, and assembly is then baked for one hour at about 80° C to cure the bond.

Using litz wire (240 strands of #22 wire supplied by the *Philadelphia Insulation Wire Company*, approximately 46 turns are wound evenly around the core shown in Figs. 1A and 1B. Termination may be made to eyelets in the ceramic caps which space the wire from the core. A suitable ceramic base and clamp bar are used to mount the assembly on a metal chassis.

The provision of a slot or air-gap in the core may be somewhat baffling at first glance. Actually, it has two purposes; one is to simplify the task of winding, and the other—far more important—is to reduce the voltage difference between the coil and core to a minimum along the winding. This will be clarified by referring to Fig. 2A. Because of the high dielectric constant (about 28) of the iron core material with 7000 volts across the coil terminals, 3400 volts appear between each terminal and that portion of the core immediately adjacent to it.

(Continued on page 23)

Fig. 2. (A) Solid core: voltage across A-B, 7000 v.; C₁, 3400 v.; C₂, 200 v. (B) Voltage distribution with solid core. (C) Slotted core: voltage across A-B, 7000 v.; C₁, 500 v.; C₂, 6000 v. (D) Voltage distribution with slotted core.





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NEW PRODUCTS

MEMORY UNIT

Composed of a solid acoustic delay line and associated circuitry, the Model 3C1-384 memory unit is a complete package ready for installation in a computer—the entire memory circuit is included in one plug-in type chassis. Used in groups in a computer, a complete memory circuit can be removed easily for servicing and a spare unit plugged in to keep the computer operating. Over-all dimensions of the plug-in chassis are 4½" x 5½" x 10".

Model 3C1-384, developed by the Computer Control Company, 106 Concord Avenue, Belmont 78, Mass., stores 384 bits at a pulse repetition rate of 1 mc. A self-contained heating element and thermal control gives temperature stability to the quartz line, and inherent accuracy of delay control greatly exceeds design requirements. The unit is especially fitted for airborne use and is insensitive to shock.

COUNTER-TIMER

The Model 5500 universal counter and timer provides a direct reading of elapsed time between any two events, a direct reading of the number of events that occur during a precise time interval, an accurate means of measuring low frequencies, and a straightforward electronic counting facility. It is being manufactured by Berkeley, a division of Beckman Instruments, Inc., 2200 Wright Avenue, Richmond, Calif.

With the Berkeley Model 5500, elapsed time over a range of 40 micro-

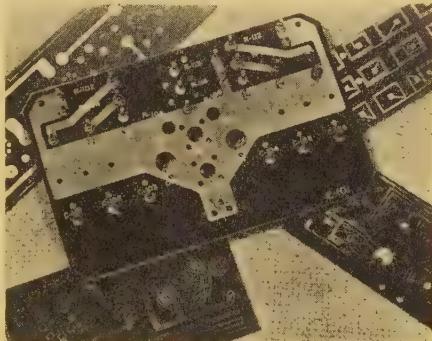


seconds to 100,000 seconds can be measured directly with a maximum accuracy of ± 10 microseconds. Events occurring regularly or with random distribution at rates from 20 to 100,000 events per second can be counted. Applications

include: relay and switch timing, timing of photographic components, and ballistic measurements.

FOIL-CLAD LAMINATES

Substantial cost savings over hand wiring methods of producing complex printed circuits for electronic equipment, hearing aids, automatic signaling devices, etc., are made possible through a number of foil-clad laminated plastics manufactured by *Synthane Corporation*, Oaks, Pa. Possessing a bond strength of from 4 to 6 pounds, copper- or aluminum-clad *Synthane* is now



available in 36" x 36" sheets with foil thicknesses from .00068" to .0094".

Accurate circuit reproduction on *Synthane* foil-clad laminates may be achieved by any commercial printing process, such as silk screening or photo-etching. Foil surfaces are guaranteed to be free of wrinkles, pits, scratches and pinholes; and uniform foil thickness assures fine line etching. The bonding adhesive is resistant to moisture and possesses good electrical properties.

LIQUID-LEVEL CONTROL

By utilizing an all-cold cathode tube design, the new electronic liquid-level control announced by *Haledy Electronics Company*, 57 William Street, New York 5, N. Y., eliminates the possibility of hot tube failure. This new control, whose only contact with liquids of both high and low electrical conductivity is made by stainless steel rods, does not require any floats, bellows or other moving parts inside a tank.

Incorporating the *Haledy* TT-1 triode tube, the control operates instantaneously and has unlimited life. The high amplification factor of the TT-1 tube

permits level detection with great accuracy.

SECONDARY FREQUENCY STANDARD

When used in conjunction with suitable microwave receiver and auxiliary signal generator, the Model



microwave secondary frequency standard will enable foolproof and rapid measurements of frequencies from 1000 mc. to 11,000 mc. to an accuracy of ± .005%. It has been announced by *Presto Recording Corporation*, P. Box 500, Paramus, N. J.

The Model 100 delivers to the 50-ohm input of a typical microwave receiver an uninterrupted series of c.w. signals spaced every 100 and 200 mc. over the complete frequency range, and a 50-marker output useful up to approximately 9000 mc. These signals are delivered simultaneously without frequency tuning.

IMPEDANCE METER

For the first time, VSWR can be measured directly and simply at highest power levels and at any desired cycle. The Narda Model 210 high-power VSWR detector, announced by *Narda Research & Development Association Inc.*, 66 Main Street, Mineola, N. Y., measures the VSWR of dummy loads, TR, ATR, system components, antennas, radar systems, standard matched loads for high power magnetrons, etc., under actual operating conditions and at any power level up to maximum peak power rating of wave guide.

In operation, the Model 210 is connected in the transmission line and operated in the same manner as conventional low-power slotted section. VSWR is read directly on a conventional VSWR amplifier, and phase is determined from the scale and vernier mounted on the instrument. At X-band, the Model 210 may be used at power levels in excess of 250 to 300 kw.

SUBMINIATURE RATE GYROSCOPE

Sanders Associates, Incorporated, 137 Canal Street, Nashua, N. H., announced production of Model 7

series of precision, subminiature gyroscopes. Less than 2" long 1" in diameter, this gyro weighs 3 ounces. It is hermetically sealed and temperature-compensated.

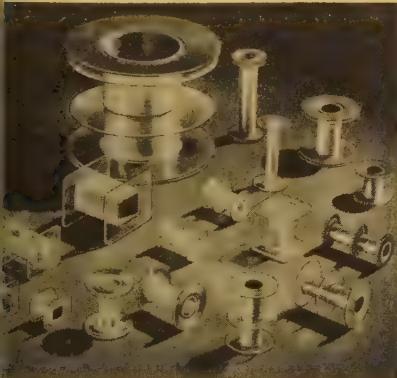
maximum linear output occurs at an rate of 420° per second. Resolution of output is better than 0.05° per sec. Sensitivity is 14 millivolts output per degree-per-second input. With a.c. output, this unit is useful in aircraft instruments, guided missiles, or antenna stabilization, fire control systems and similar applications.

MINIATURIZED PULSE TRANSFORMERS

A new line of miniaturized pulse transformers for blocking oscillator applications has been announced by theon Manufacturing Company, Waltham, Mass. Designed with a choice of several different wiring connections, these miniaturized units are available in three different styles. One style has plug-in octal base construction, another has a hermetically sealed MIL-7 construction, and the third is an encapsulated version with a built-in hermetic seal for chassis mounting.

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circuits—and other electronic applications requiring high insulation properties—are now available from the Precision Paper Tube Company in any size, shape, I.D. or O.D., and in any quantity.

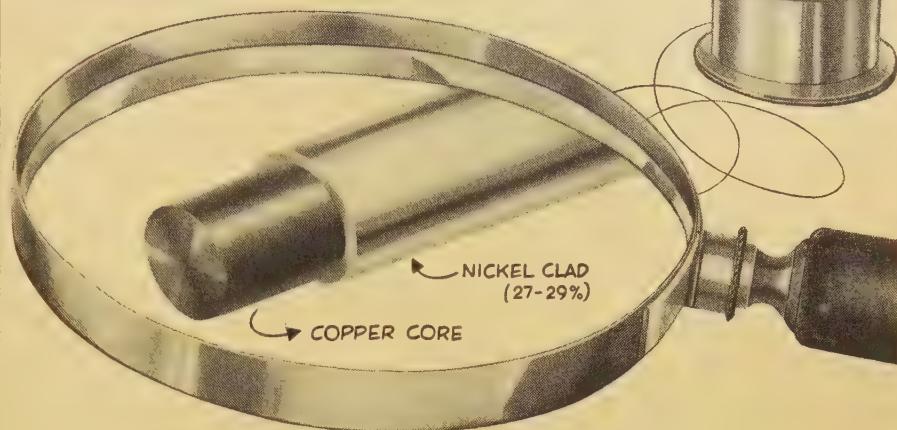
These bobbins can be supplied in all-state construction, combination acetate and dielectric paper, and with glassized fibre or metal flanges. They can be fitted with flanges to meet any specification. In the case of coil forms for relays, etc., where brass shading rings are employed to concentrate magnetic field, acetate shields

(Continued on page 30)

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LOOKING at TUBES

By WILFRID B. WHALLEY

Adjunct Professor of Electrical Engineering
Brooklyn Polytechnic Institute

Picture reproducing tubes for color television.

TO ADD COLOR to television requires basic changes in pickup and reproducing devices. For operation of any color television system, the most needed device is one which reproduces the color picture satisfactorily. Intensive efforts over a long period, in both research and development, have been devoted to obtaining satisfactory tricolor tubes.

As discussed previously (*RADIO-ELECTRONIC ENGINEERING*, May, 1953), color television systems can be divided into two basic groups: those in which the color information is associated with the synchronizing pulse, and those in which the color information is associated with a subcarrier.

In the first group, there is the field sequential color system, where the rate of color switching is low enough so that mechanical control of the colors can be used as well as electronic control. In the second group, the rate of switching color information—from three to four megacycles—is too high for mechanical switching to be practicable.

Single Tube Display

While waiting for satisfactory electronically controlled tricolor picture tubes, field sequential color systems have made use of standard monochrome picture tubes. This has been done by placing color control devices between the picture tube and the viewer.

One arrangement made use of the polarization and refraction of light rays by large, single, translucent crystals. When a high voltage is applied

between the two faces of such a crystal, light rays passing through are doubly refracted. Hence, it was possible to build experimental assemblies of two such crystals and—by choosing three successive voltage groupings—pass only the red, green or blue light from the white source of a standard kinescope.

Wratten filters have been used in combination with a rotating color disc or drum, somewhat similar to the type used in field sequential pickup cameras but having necessarily larger dimensions. Color television receivers with 17" rectangular picture tubes in a suitable color drum have been demonstrated. In this arrangement, the segments of the disc or drum contained red, green and blue filters placed in the same order as those of the camera. The edge of each filter moved progressively downward with the normal downward scanning of the tube electron beam, and by the time the beam recommenced writing at the top of the tube, the next color filter was in position. The disc was locked-in with the vertical synchronizing pulses by one of several methods.

In one of these methods, a small reluctance-type generator was mounted on the shaft of the color disc. The rotor of the generator was so-shaped as to produce an output voltage having a saw-tooth waveform. The generator voltage and a negative polarity pulse from the receiver vertical deflection circuit were connected to a phase detector. The output of the detector then controlled the d.c. current through a saturable reactor. Since the disc drive

motor was connected through the reactor to the a.c. supply voltage, the speed could be automatically controlled.

Regarding the picture tubes employed with the filters, it was found that relatively large tolerances in the phosphor properties were permissible, so long as the

light output contained a reasonable amount of red energy.

Using a standard good-quality picture tube, there was no limitation upon resolution in the reproducing device. The resolution obtainable was the same as for monochrome operation, since the color segments in the disc acted only as light filters and had no effect upon size. It may also be noted that the producing tube had only one electron beam, and therefore there were no problems of registration such as can occur with more recent types of multibeam tricolor tubes.

Multiple Tube Display

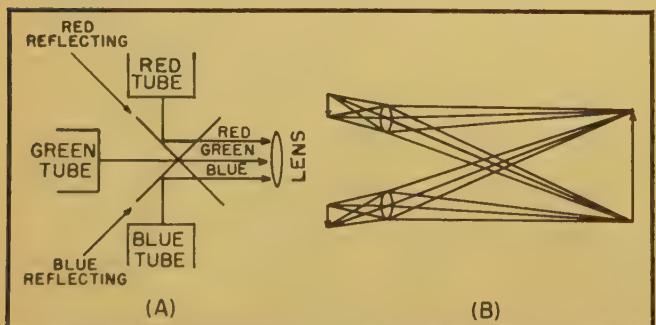
In those systems which have either "simultaneous" color or high speed switching controlled from a subcarrier assemblies of three monochrome picture tubes were first used. Each of the tubes supplied the light image corresponding to one of the primary colors e.g., the red tube was supplied with signal corresponding to the red information in the scene.

In one early arrangement called the "triniscopic," three projection tubes were rigidly mounted in a vertical assembly, equidistant from each other and with parallel axes. The 3" tubes were as similar to each other as possible except for the screens which had phosphors to give respectively red, green and blue light output. Each tube had a projection lens to focus the raster via a reflecting mirror, onto the back of a translucent viewing screen. The three lenses were carefully adjusted and clamped to bring the three superimposed pictures into as accurate registration as possible. Figure 1B is a two-dimensional sketch of such an arrangement.

Later, a direct-view three-picture tube assembly was made (Fig. 1A). Three 10" tubes were mounted in a heavy steel frame, one tube with its axis horizontal, one vertically facing downward, and the third with its axis vertical but face upward. Dichroic mirrors placed between the three tube faces brought the three light images together for the observer and also provided the color information.

Such operation required rigid mechanical supports for the tubes and three deflection yokes as similar in construction as possible. The horizontal axis of each yoke had to have the same angle with respect to the vertical axis within a few minutes of arc, so that the three rasters would be of similar shape. Also, the width, height and centering circuits had to be carefully adjusted in order to obtain reasonable registration. Even a very small difference between one yoke and another could cause electrical misregistration of the three images over one or more portions of the scene.

Fig. 1. (A) Registration with three dichroic mirrors and one lens. (B) A method of optical registration.



h Q Toroid

tinued from page 18)

cent to it. Only about 200 volts appear across the small portion of solid included between the terminals. Figure 2B shows the voltage distribution on both core and coil referred to end (A) of the winding. The great disparity between the potential of the iron and that of the coil causes heating of the core and increases the possibility of a shaver occurring on modulation.

Figures 2C and 2D show the condition which prevails when a large air-gap is in the core between the coil terminals. Capacity between terminals through the core has been drastically reduced, thus transferring the high voltage difference from the "coil-to-air-gap" gap to the "iron-to-iron" gap. The resulting favorable voltage distribution along the coil and core is illustrated in Figures 2C and 2D.

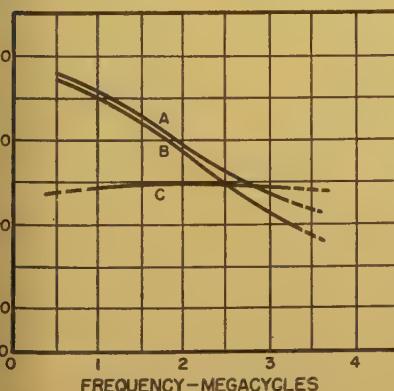
The net effect of the air-gap in the core as just described is not only to protect the toroid against high voltage shavers in high power r.f. circuits but also to increase the *Q* by reducing electric losses in the powdered iron core.

Figure 3 shows how the *Q* of such a toroid varies with frequency with coil A having litz and solid wire, air-gap and solid core.

Development work on this low-loss *Q* was performed while the author was employed by the RCA Victor Division of the Radio Corporation of America in Camden, N.J. All *Q* measurements were made with the Boonton Model 160-A *Q* meter, with readings selected for distributed capacity.



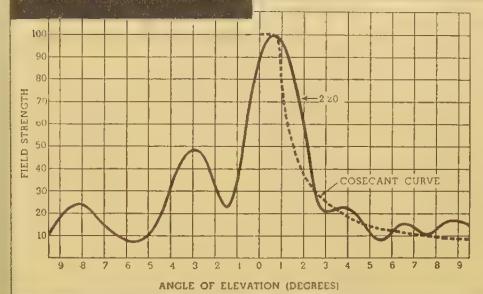
Fig. 3. Frequency vs. *Q* for three different coil and core combinations. Coil A has a slotted core and is wound with a single layer of 46 turns of 240/44 litz wire; inductance, 40 μ hy. Coil B has a solid core wound with 240/44 litz wire. Coil C has a slotted core wound with .040" diameter solid copper wire. Core material is Henry L. Crowley #D-1 SS carbonyl with an outside diameter of 2" and an inside diameter of 1 1/4". Each coil is spaced approximately 1/16" from the core.



THE NEW WORKSHOP COSECANT UHF ANTENNA for Television



Cross-sectional view showing the four vertical tubes that form the radiating structure. These tubes are actually slots and are further subdivided into resonant sections. They are fed by a single vertical inner conductor.



Radiation pattern of Model WA-25-XX with null fill-in and beam tilt of 0.65°.

To meet the entire range of broadcast requirements from small isolated communities to large metropolitan areas, the Gabriel Laboratories has designed a high-gain UHF television antenna for the Workshop which combines simplicity, ruggedness, and reliability.

With 25 and 14 power gain models in production, plus another with smaller gain, in development, this new antenna can be supplied to fit the special conditions of any broadcast area. Its radiation pattern is the closest approach to a cosecant curve of any antenna now available. Null fill-in, if desired, is built in electrically — not just a compromise with ground reflections. Beam tilt is also available to provide maximum coverage and field strength.

Simple mechanical design results in a relatively low-cost antenna which has no insulators except for gas seal, no de-icing problems, and no field repair problems. The plastic weatherizing windows which protect the radiating structure are dyed "international orange" so that the antenna never requires painting. Galvanized, welded steel construction assures excellent rigidity, corrosion resistance, and long life.

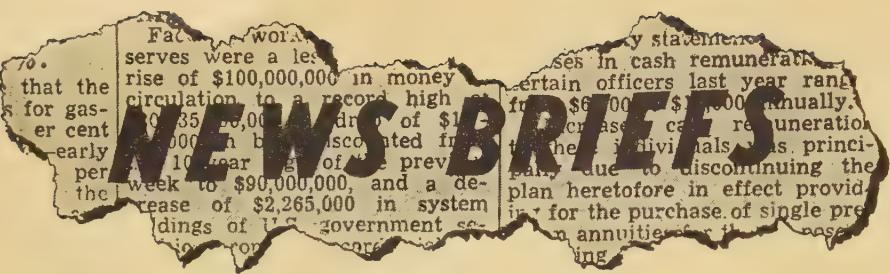


WORKSHOP ASSOCIATES DIVISION

THE GABRIEL COMPANY

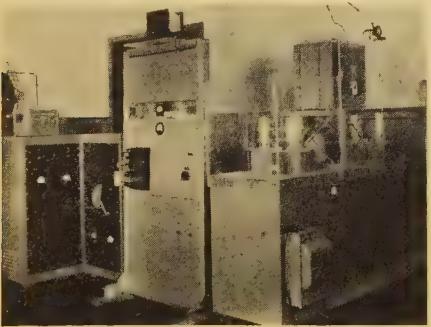
ENDICOTT STREET, NORWOOD, MASS.

DESIGNERS AND MANUFACTURERS OF A COMPLETE LINE OF MICROWAVE ANTENNAS



IONOSPHERE RECORDER

Due to increased interest in low-frequency radio propagation phenomena, the National Bureau of Standards has developed a low-frequency recorder to probe the ionosphere. Operating frequencies of 50 to 1100 kc. are produced by using the beat frequency method of generating wide frequency sweeps. Wide-band transmitter amplifiers



ifiers, which utilize transformers containing ferromagnetic cores, deliver over 200 kw. of pulsed power; but an inefficient antenna system must be used because of physical limitations.

The rack at the left of the photograph contains mixing equipment for producing the difference frequency between two oscillators (in the adjoining rack), one of which is a continuous-wave oscillator variable in frequency from 2 to 3.1 mc., the other a pulsed oscillator at a fixed frequency of 2 mc. The final amplifiers are in the plastic-enclosed unit at the right.

WESCON PROGRAM

The technical program for the Western Electronic Show and Convention, to be held in San Francisco, August 19-21, will consist of 17 sessions with approximately 85 papers to be given. WESCON is jointly sponsored by the IRE (Seventh Region) and the West Coast Electronic Manufacturers Association.

Subject to minor changes, the program will include: two sessions each on antennas, propagation, electron devices, circuits, and computers; and one session each on airborne electronics, microwave techniques, servos and tele-metering, instrumentation, transistors, and nuclear radiation measurements. Of the evening sessions scheduled, one

will be on medical electronics, another on audio, and a third on generalized topics of broad scope.

PCA EXPANSION

PCA Electronics Inc., 2180 Colorado Avenue, Santa Monica, Calif., has announced an expansion of its activities to cover commercial and military types of transformers and toroids in addition to the PCA line of miniature pulse transformers. Standard filament transformers, plate transformers and chokes designed to meet MIL-T-27 test specifications are now available.

P2V-5 FLIGHT SIMULATOR

With the delivery of the first P2V-5 Flightronics airplane simulator, the Navy now has an economical and safe method of training pilots and copilots to fly the long-range flying arsenal. Designed and built for the Special Devices Center, Office of Naval Research, by *Engineering and Research Corporation* of Riverdale, Md., this device is the electronic equivalent of the P2V-5.

The ERCO flight simulator is basically an electronic computer in which all the forces acting on the airplane in flight, including the pilot's control

the results of which indicate that most resistor types have erratic fluctuations that vary from 1 or 2% to more than 10%. Even the best resistors have variations of from 0.5 to 1%. The study also showed that voltage changes from 1.5 to 180 volts cause resistance variations ranging from 0.4 to 26.5%.

Resistances were measured to an accuracy of 0.1% by an NBS technique



which utilizes a vibrating reed electrometer as a null detector in a bridge network and involves the use of standard resistors either directly as components in the circuit or as auxiliary calibrating units to replace the unknown resistor. As shown in the photograph, the charge flowing through a resistor during the time of measurement is obtained from a variable air capacitor maintained at a fixed potential. The potentials across the capacitor—and thus across the resistor—are obtained from a potential divider and are monitored by the electrometer. A null condition is maintained by increasing the capacitance at the proper rate by means of a speed-controlled motor geared to the shaft of the capacitor.

INDUSTRIAL APPOINTMENTS

Recent appointments to the technical staff of *Designers for Industry*, Inc., Cleveland, Ohio, an industrial product development organization, include Patrick E. Lannan, Theodore H. Smith, and Dr. Charles H. Lutz, as assistant project managers; Robert B. Applegate, as senior project designer; and Erwin W. Graham, as project designer.

Mr. Lannan will be responsible for electronic development projects at the company together with Mr. Smith and Dr. Lutz; Mr. Smith was promoted to his present position from senior project designer.

"AUTOMATION" DISPLAY COACH

"Automation" has been put on wheels by the *Westinghouse Electric Corporation*. As the theme of a unique display coach developed by the Standard Control Division, it is being taken directly to design engineers, maintenance men, and supervisory personnel in the machinery manufacturing industry throughout the United States. A mobile



forces, are considered as items in a number of equations. The "computer" solves these equations instantly and continuously, and the answers provide instrument indications identical to those of the aircraft.

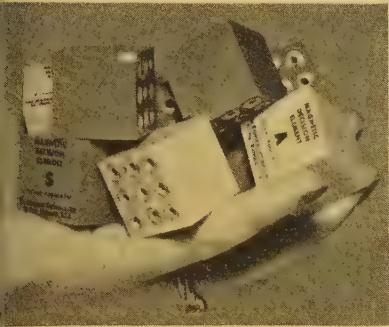
RESISTOR MEASUREMENTS

A three-year study of multimegohm resistors has recently been completed by the National Bureau of Standards,

ination of the best features of an auditorium and exhibit hall, the coach says how common electrical devices as line starters, control stations, starters, and circuit breakers—the "nuts and bolts" of any electrical system—be used to achieve successful automation.

MAGNETIC DECISION ELEMENTS

Magnetic decision elements, now being produced by The Minnesota Electronics Corporation, 47 West Water Street, St. Paul 1, Minn., are completely basic, completely flexible building blocks. Using only two types, termed "S" and "A," it is possible to build the



arithmetic, program, control and memory sections of any digital computer—including both serial and parallel systems.

The standard "S" and "A" elements are designed with Hubbell interlock connectors for rapid cascading in any desired performance pattern. They contain no electron tubes or transistors. All components are cast in an epoxy type of resin.



Pressure Testing

(Continued from page 8)

be obtained by tests of one or two tubes, since they represent too small a sample. The pressure tank must be large enough to accommodate a number of tubes at one time, thus allowing tests to be conducted on a group of tubes to obtain more reliable data. The tank now in use for this purpose at Seneca Falls has a capacity of 800 cu. ft. and is 27' long by 6' in diameter. One end of the tank has a gasketed cover which is sealed airtight by 44 1" x 6 1/2" long steel stud-and-nut assemblies. The maximum allowable working pressure of the tank is 60 psi. Safety valves, or "pop-off" valves, are set at the maximum working pressure of the tank. An automatic controlled air pressure system is provided, together with a continuous seven-day pressure recorder. Once the system is put into operation at the desired pressure, the tank may be left unattended except for regular checks on the progress of the test.

Tests are usually conducted on groups of ten or twelve tubes at a time. Each tube is placed in a cardboard carton to protect it from flying particles in case a nearby tube fails. In order to monitor each tube from outside the tank and to make a daily check on tube failures, electrical cables are connected to the filament of each tube. The cables are then passed through a pressurized fitting in the tank and finally terminated at an indicating device. This device consists of a transformer in series with a group of microswitches. Each switch, when depressed, isolates the tube being monitored and checks for continuity of filament by means of a current meter. (See Fig. 2). If the tube has failed, there will be no current indicated on the meter.

When tests are conducted in the air tank upon bulbs which have no filaments, i.e., unfinished tubes, a trigger mechanism is attached to each bulb. This closes a control circuit in the event of tube failure and records it at the outside control position which is under observation of the operator.

Tests are being run continuously in this tank on all types of glass and metal bulbs and tubes. The data compiled has yielded valuable information on the mechanical properties of picture tubes.

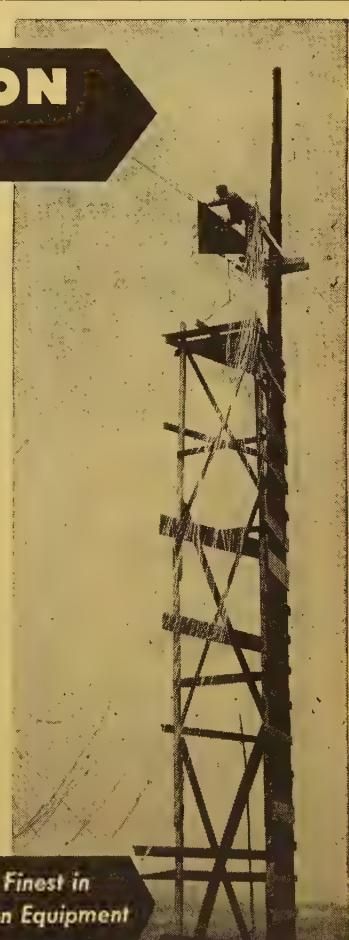


SKL WIDE-BAND DISTRIBUTION SYSTEM FOR TELEVISION



The -SKL- Distribution System provides simultaneous distribution of up to thirteen television channels, FM signals, and, if required, broadcast signals. Although the -SKL- system is inexpensive in initial cost, no effort has been spared to provide high quality, long lasting, low obsolescence designs and equipment. An unusual feature of the -SKL- system is the Model 212TV Chain Amplifier. These broadband amplifiers continue to operate even though a tube fails, which insures the high reliability so necessary in such a system. The -SKL- system is designed to have the lowest maintenance cost of any system on the market today, not only because of the reliability of the amplifiers which require no tuning or adjustment, but also because vacuum tubes have been eliminated in all other parts of the system. Only the -SKL- system can offer the long life, low obsolescence and low maintenance costs that are required for the long, profitable operation of distribution systems.

Write today for further information.



Views of SKL Model 420 Amplifier mounted on a telephone pole crossarm (top), pole (bottom). Courtesy Vermont Television, Inc.

Right: Photo of erection of one of the two Horn Antennas at Barre, Vermont, for Vermont Television, Inc. These antennas, having 20 db gain, provide good signals from WBZ-TV Boston, 140 air miles, and WRGB Schenectady, 130 air miles.

SKL SPENCER-KENNEDY LABORATORIES, INC.
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The Finest in
Precision Equipment

Lumped-Constant

(Continued from page 7)

what difficult to wind, and breaks easily when being twisted at the tap. Also, smaller the wire size, the higher the resistance, and therefore the greater the attenuation within the passband.

If the design calls for a wire smaller in diameter than #38, it is best to choose another form diameter and repeat the calculation for the number of turns. Where the physical size of the winding is important and the above calculations require a large form factor, the use of universal wave coils can radically reduce the size. Each coil should have an inductance equal to L_1 , and the spacing between coils should be adjusted for the correct M . Spacing of a good dielectric material, such as XXXP Synthane or Rexolite, should be used to control the spacing between coils.

After the line is constructed, its frequency response can be measured either by a signal generator or a sweep generator and wideband scope or a diode detector. The measurement of delay vs. frequency is somewhat difficult, and Kallmann indicates a method which can be used, together with the necessary equipment for measurement. When square-wave testing a delay line, care must be exercised. All leads must be short, the square-wave generator should be properly terminated, and all connections—particularly ground leads—should be of low impedance. In some cases, the above will indicate that a matching network is necessary. A simple half-section can be used, or an m -derived half-section with an m of 0.6. However, as an m of 0.6 permits both coils to be identical, a value of 0.5 is suggested because of the simplification it allows and because of the excellent results which it is capable of yielding.

There are several methods of measuring the delay and characteristic impedance of a line after it is constructed; however, the following method has been found to be quite simple and of reasonably good accuracy (see Fig. 6). A square wave generator is properly terminated, and the symmetry controlled so that both halves of the square wave are of the same duration. Frequency is carefully set to a known value, e.g., 10 kc. The coaxial lead from the generator to its termination should be as short as possible. A resistor whose value is equal to the theoretical Z_0 of the line is connected from the generator to the input terminal, and the line's ground end is connected to the generator's ground through means of a low inductance condenser. To measure the delay, the probe of a wide-band scope is connected across terminals A and B , with Z_0 purposely mismatched.

Personals



DR. MICHAEL J. DITORO will head electronic development in the engineering department of the *Fairchild Guided Missiles Division of Fairchild Engine and Airplane Corporation*, Wyandanch, L. I., N. Y. Well known for his work in communications and missile instrumentation, Dr. DiToro was associate director of the Microwave Research Institute of Brooklyn Polytech for a time. He has also filled important engineering posts in leading electronics firms.



EDWIN B. HASSLER, who was formerly with *Motorola Inc.*, has been appointed director of engineering to head the new research and development laboratory being opened by the *Warwick Manufacturing Corporation* at 4740 West Madison Street, Chicago, Ill. He will be in charge of radio, television and electronic product development and the testing and improvement of component parts, including transistor and printed circuit research work.



JOHN H. HOWARD, senior research engineer in the Research Activity of *Burroughs Corporation*, Philadelphia, Pa., has been named chairman of two professional groups: (1) the 1953 Joint Computers Committee of the AIEE, the IRE, and the Association for Computing Machinery, and (2) the IRE Professional Group on Electronic Computers. Mr. Howard is a Navy veteran of World War II, and holds an M.S. degree in electrical engineering from MIT.



BERNARD T. SVIHEL has been placed in charge of the new Electronics Division of *The Kuljian Corporation*, Philadelphia, Pa. With over 15 years experience in the radio and electronics industry, Mr. Svihel has been responsible for extensive design and research work on analog computers, differential analyzers and servomechanisms. He is a former member of the electrical engineering staff at MIT, and was with the Franklin Institute for several years.



DR. CONSTANTIN S. SZEGHO, director of research of *The Rauland Corporation* since 1942, has now been appointed vice-president in charge of research. His improvements in cathode-ray tubes and other special tubes have been major contributions to the television tube industry. Before coming to America in 1940, Dr. Szegho was chief of the vacuum tube laboratory for *Baird Television, Ltd.* of London. He received his doctorate in 1931.



CHARLES E. TORSCH has been appointed chief television engineer for *The Rola Company, Inc.*, division of *The Muter Company*, which makes sound-reproducing and electronic equipment. With wide experience in the entire field of television circuitry and components—including association in various capacities with *G-E*, *RCA*, and *Bendix Radio*—Mr. Torsch has 15 patents to his credit and is a regular contributor of technical articles.

waveform on the scope will be similar to the waveform which is sketched in Fig. 8.

The period of the square wave, T_L , is twice the delay of the line. If the scale of the scope is calibrated in cm., the delay can then be easily measured. By adjusting the value of Z , as shown in Fig. 8 can be made to disappear, and the value of R at this point is the characteristic impedance. When the line is properly terminated, the load should be connected to C and D . The response of the line can then be observed. If a portion of each of the capacitors is made up of a trimmer capacitor, these trimmers can be adjusted so that the ripples in the square wave are at a minimum.

Figure 1 is a photograph of a commercially available constant k line, and Figure 11 is a plot of the frequency response of this line with the method of measurement indicated. Six db of attenuation is a result of the method of measurement, and therefore the line has an attenuation of 1.6 db below 1 mc. Since the line has found many applications where its limitations are not important, such limitation is nonuniform deviation from the frequency as indicated in Figure 4. Figure 4 is a photograph of a 100-microsecond square wave before and after being passed by this line.

The cost of the line is quite low and it is a very rugged unit which can easily be incorporated in a new or existing design. Where a longer delay is required, two or more of these lines may be used in series; where a smaller delay is required, taps are provided at 0.05-microsecond intervals.

The coil form is a laminated plastic which has pins driven into it for coil terminals and tap points. The rod is wound in a modified coil winding manner, and the coils are wound between the pins. The wound rod is then varnished and inserted into the frame where the capacitors are connected to it. A photograph of this construction technique is shown in Figs. 1 and 2.

Figure 2 is a photograph of a delay line which forms a part of a commercially available television synchronizing pulse generator. Each section of this line has a delay of 0.1 microseconds; the total delay is 18 microseconds, and the characteristic impedance is 1000 ohms. The frequency response is down to 3 db at 900 kc., and the total attenuation is 3 db from the resonance point of 1 kc. In operation, a 1-kc. pulse is fed into the line, and at the required intervals of delay is brought out of the line.

REFERENCES:

4. Kallmann, H. E., "Equalized Delay Lines," *Proceedings of the IRE*, Vol. 34, p. 646, September, 1946.
5. Moskowitz, S., and Racker, J., "Pulse Techniques," p. 84.
6. Lester, J. M., "Transient Delay Line," *Electronics*, Vol. 10, No. 4, p. 14, April, 1946.



TUNED REFLECTORS

(Continued from page 15)

The efficiency of the reflector will be approximately 72%.

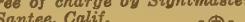
Use of Fig. 4B makes it possible to determine reflection efficiency changes by changing the frequency for a series of stated angles. This graph may be useful if very wide modulation is employed. The change of efficiency is negligible if the frequency deviation is small percentagewise with respect to the carrier and if the carrier is near the maximum efficiency frequency for that angle. Taking a reflection angle of 60° and a frequency 1.3 times the cutoff frequency (f_c), a line is drawn normal to the abscissa at the point marked 1.3 on the frequency scale. From the point at which this line intersects the 60° curve, a line is drawn parallel to the abscissa. The % efficiency is read from the point at which this line intersects the ordinate. Using a frequency of 1.3 f_c , the efficiency is found to be approximately 72%. Using a frequency of 1.6 f_c and an angle of 60°, the efficiency will be found to be approximately 89%. Likewise, a frequency of 2 f_c will be 100% efficient with an angle of 60°.

The reflection efficiencies plotted in Figs. 4A and 4B refer to a direction symmetrical to that of the direct beam, namely, to the direction in which light would be reflected if the reflector were a mirror. In this case, it is obvious that the light intensity would decrease abruptly by moving off the reflected light beam. The same thing happens with the microwave reflected beam. Figures 4A and 4B give the reflection efficiency for the center of the reflected beam. Moving away from this direction, the reflected power also decreases, although not so abruptly as in the case of the light beam. This decrease is due to secondary lobes which are caused by diffraction. Diffraction, in turn, is due to the fact that the dimensions of the reflector are comparable with the wavelength—the smaller the reflector, the greater the diffraction effect. Diffraction, in this case, may be defined as the deviation of the radio beam from a straight course resulting from the edge effect of a relatively small reflecting surface.

BIBLIOGRAPHY:

U. S. Patent No. 2,622,242.

"Introductory Concepts to Microwaves," a handbook distributed free of charge by Sightmaster of California Co., Santee, Calif.



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NEW LITERATURE

ELECTROFORMING

The process of electroforming—the production or reproduction of a formed article by electrodeposition of metal—and its various applications are discussed in an eight-page booklet published by Bone Engineering Corporation, 701 West Broadway, Glendale 4, Calif. Facilities of the Bone Engineering Corporation for the design, manufacture and testing of electroformed products, are also presented.

SWITCHES

More than 150 types of switches are illustrated in the 16-page catalog recently published by Wells Sales, Inc., including toggle and leaf switches, miniatures, plunger types, roller and wafer switches, vacuum pressure types, circuit breakers, timers, and many others.

Write to Wells Sales, Inc., 333 W. Chicago Avenue, Chicago 22, Ill., for

your copy of Catalog No. C-11. Prices and specifications of hundreds of types are listed.

DRIVE SYSTEMS

Westinghouse "Life-Line" AV-drive is a complete, adjustable-voltage drive system—a factory-engineered package. Flexible in application, it may be used wherever control of a d.c. motor from an a.c. power line is required.

Type AV-drive is described in a 16-page booklet available from Westinghouse Electric Corporation, Merchandise Mart Plaza, Chicago 54, Ill., which sets forth the advantages of the system, basic operating principles and construction features.

CAPACITORS

A 28-page brochure, just published by Aircraft-Marine Products, Inc., provides design and test data on AMP

"Capitron" capacitors and pulse forming networks. These components are designed for the specific requirements of the equipment in which they are used.

Illustrated with reproduction actual test charts, the book pays particular attention to "Ampli-
a new synthetic dielectric which makes it possible to effect tremendous reductions of size and weight in capacitors and pulse forming networks. Requests for copies should be addressed to Aircraft-Marine Products, Inc., 2100-ton Street, Harrisburg, Pa.

DELAY CABLES

Columbia Technical Corp., 557th Street, New York 22, N. Y., released a four-page folder on Type HH-1500 and Type HH-2000 impedance delay cables which contains a general description of the specifications, pulse response diagrams and a list of specific applications in electronic circuits.

The outstanding feature of both these cables is a continuous, uniformly flexible, low-loss magnetic core which effectively increases the characteristic impedance of each cable as well as the time delay, while maintaining the dimensions of standard $\frac{1}{2}$ " RG coaxial cables.

VOLTAGE DOUBLER DEMODULATOR

By A. Q. MORTON

WHILE DOING atomic research in England, Messrs. Cockcroft and Walton were faced with the need to increase d.c. voltages available from a.c. sources. They found it convenient to achieve this increase by using the voltage doubler rectifier circuit sometimes found in power supplies. Such voltage doublers can be cascaded to give an output of four or eight times the input, although in practice the output is never just twice the input and too many stages are inefficient.

This voltage doubler has been widely used not only in nuclear research but also in domestic TV receivers where it provides the high voltages needed to use larger or aluminized picture tubes without too much internal change; in these applications high voltage selenium units

are employed. The circuit is now coming into use in high fidelity tuners where it will give a better performance than can be achieved with the demodulators generally used.

A typical circuit suitable for a 6H6 tube is given in Fig. 1. Each half of the tube acts as an ordinary diode; it passes half the carrier in the form of pulses, the amplitude of which depends on the a.f. modulation. The combination of the pair offers considerable improvement over conventional demodulators, for the inputs are always equal and opposite; so are the outputs, and they are combined in the load resistance just as the outputs of a push-pull stage are combined in an output transformer with the same harmonic cancellation.

The price to be paid for this improvement is low input impedance; in the circuit given, the load on the previous stage is about 30,000 ohms, but in high fidelity tuners this might mean no more than the saving of a damping resistor. Tuning is very flat and is best done, as indicated, with a meter. The usual precautions should be taken to insure that the a.f. and a.g.c. resistors are more than five times the load resistor; the low value of the volume control makes this task simple.

A test was conducted to determine the distortion introduced by this demodulator. Compared to a single diode on a 5-volt signal 80% modulated, distortion was reduced 18 db. Compared to an infinite impedance demodulator, the improvement was 16 db and a source of a.g.c. was provided.

TUBE DEVELOPMENTS

Technical advances which make possible the manufacture of better electron tubes and transistors are described in a group of research reports reviewed in the April issue of the Bibliography of Technical Reports. General topics covered include tube development, magnetron developments, and transistor and semiconductor advances.

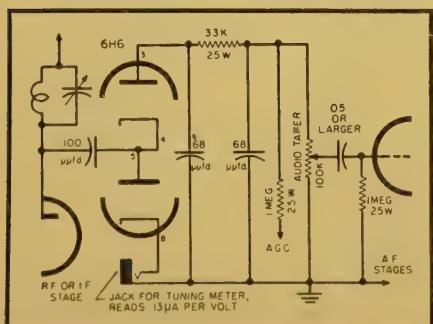
The April issue of the Bibliography is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for 25 cents a copy. Check or money order should be made payable to the Treasurer of the United States.

GLASS FIBER INSULATIONS

Three new lightweight acoustical glass fiber blanket insulations are described in a four-page folder published by the Gustin-Bacon Manufacturing Co., 210 W. 10th Street, Kansas City, Missouri. These blankets weigh only six ounces per square foot or less and are said to possess excellent thermal and acoustical properties.

"Ultralite" is a textile-type, glass fiber insulation bonded together with a thermosetting plastic. "Ultrafine" insulation is composed of very fine glass fibers bonded

Fig. 1. Circuit diagram of the Cockcroft-Walton voltage doubler demodulator with component values.



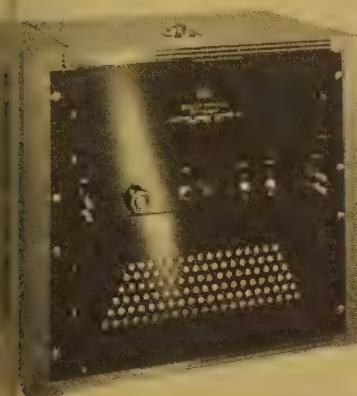
permeosetting plastic resin; and "Acoustic" is a combination of the two insulations separated by a septum.

POWER SUPPLIES

Bulletin No. L453, covering Perkin-Elmer amplifier regulated power supplies for laboratory testing applications, describes high-voltage and low-voltage power supplies with regulations to .15%. This eight-page bulletin may be obtained by writing on a company letterhead to the Perkin-Elmer Corporation, 345 Kansas Street, El Segundo, Calif.

POWER AMPLIFIER

A new SIE Model B d.c. power amplifier is described in a four-page brochure available from Southwestern Industrial Electronics Co., 2831 Post Road, Houston 19, Texas. Electrical



Mechanical specifications are given, as well as a simplified schematic diagram of the unit.

Capable of providing substantial output power from standard signal sources, this instrument has essential linear response from 0 to 20,000 cps. It will deliver 6.25 watts into a 100-ohm load when driven by a 10-volt d.c. source.

RELIABILITY TUBES

The essential characteristics of G-E Star miniature and subminiature reliability tubes are described in a booklet published by the General Electric Company. Included in the data are the specific differences between individual tubes and their standard-tube types, heater ratings, maximum anode center ratings, and operating characteristics.

Copies of this eight-page booklet may be obtained by requesting publication D-548-A from the General Electric Company, Tube Department, 1 River St., Schenectady 5, N. Y.

TECHNICAL BOOKS

"PULSES AND TRANSIENTS IN COMMUNICATION CIRCUITS" by Colin Cherry. Published by Dover Publications, Inc., 1780 Broadway, New York 19, N. Y. 317 pages. \$4.50.

Intended as an introduction to network transient analysis for television and radar engineers, this book bridges the gap between simple conventional alternating current theory and operational methods of analysis. Using rigorous physical arguments and only elementary mathematics, it provides the essential groundwork for the study of transients.

Topics covered include: the basis of network analysis, waveforms and spectra of electric signals, selectivity characteristics of networks, transient response of networks, simplification of transient response calculations, characteristics of multistage amplifiers, calculation of the distortion of signals, and the response of networks to very short impulses.

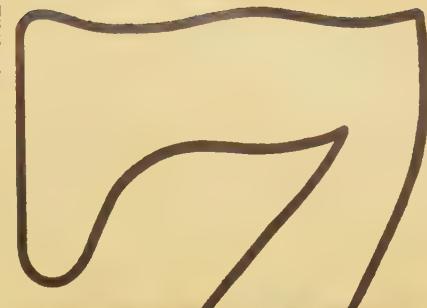
References to many published books and papers appear at suitable points in the text. Mathematical language and notation are avoided as much as possible; electric waveforms are dealt with rather than analytical functions.

"MICROWAVE SPECTROSCOPY" by Walter Gordy, William V. Smith and Ralph F. Trambarulo. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 446 pages. \$8.00.

One of the aims of this book—the first one to be written on the subject—was to provide for microwave spectroscopists, chemists, physicists, and other scientists a conveniently available source of the large amount of information which has been obtained to date through microwave spectroscopy. This information is summarized in various tables. In addition, a bibliography is provided.

Another objective was to facilitate the analysis and interpretation of the microwave data accumulated. Pertinent formulas are given in forms most convenient for analysis, and numerical tables are provided as an aid in the analysis of the spectra.

This book makes it easy for the beginner to become familiar with the instruments and experimental methods of microwave spectroscopy. The fundamental theory involved in the detection of microwave absorption lines is given with detailed descriptions of spectrographic components.



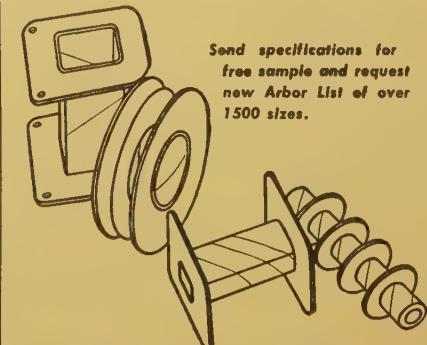
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New Products

(Continued from page 21)

are used to insulate the coil from the ring. For further information, write to *Precision Paper Tube Co.*, Dept. R5, 2051 W. Charleston Street, Chicago 47, Ill.

MAGNETIC AMPLIFIERS

A line of magnetic amplifiers has been introduced by *Karl-Douglas Associates* for precision control and amplification of a.c. current. These low-cost devices are said to perform the functions of present vacuum-tube or motor-type regulators, but in addition feature instantaneous operation and indefinite life. They are immune to both shock and vibration and are protected by a special plastic potting compound which assures maximum dielectric strength and good



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These amplifiers can be engineered to operate from any single or polyphase a.c. supply voltage at frequencies ranging from the lowest power frequencies to megacycles. Under certain conditions, amplifications of 1 to 1,000,000 are possible. For specific information or an informative folder, write to *Karl-Douglas Associates*, 3160 W. El Segundo Blvd., Hawthorne, Calif.

COMPUTER MECHANISM

All of the elements needed for precise, high-speed handling of half-inch magnetic recording tape are contained in the computer mechanism for recording and storage of digital data which has been placed on the market by *Raytheon Manufacturing Company*.

The *Raytheon* magnetic tape mechanism may be operated automatically by pulsed input signals or controlled manually by a front panel switch. It moves from stop to start or vice versa in less than five milliseconds, with smooth acceleration, deceleration or reverse. The magnetic head has six channels, narrow gap, with high frequency response. This head assembly is accurately and permanently aligned, although it can be readily removed, replaced, or interchanged.

Inquiries should be addressed to the Technical Sales Department of *Raytheon Manufacturing Company*, Waltham, Mass.

WAVE GUIDE ATTENUATOR

Direct and precise readings from 0 to 50 db are given by the Model X382A wave guide attenuator which has been developed by *Hewlett-Packard Company*, 395 Page Mill Road, Palo Alto, Calif. Now being offered only for X-band use at frequencies from 8200 to 12,400 mc., the Model X382A has a VSWR of less than 1.15 throughout the range. Zero setting attenuation is less than 1 db.

Readings are completely independent of frequency, phase shift is independent of attenuation setting, and accuracy is within $\pm 2\%$ of db reading. The design



of this instrument is unique in that the attenuation depends on the angular position of the attenuating film rather than on its specific resistivity. Model X382A employs three resistive films—two mounted in line within each wave guide extension, and a third rotatable axially in the center section. Rotating

the center film increases attenuation proportionally to the cosine square of the angle of rotation.

VARIABLE DELAY LINE

The Type 702 step-variable delay consists of 55 sections of lumped-parameter LC filter networks. Each section of these networks was specially



designed to give (1) linear phase shift up to 70% of its cutoff frequency, (2) a frequency response curve which is Gaussian in shape. As a result, Type 702 produces essentially zero overshoot and has a very rapid rise time—less than 0.45 microsecond at any step.

Developed by *Advance Electronic Co.*, P. O. Box 394, Passiac, N. J., Model 702 has a time delay which is variable in steps of 1 microsecond to 10 microseconds by means of a four-position push-button switch. Characteristic impedance is 190 ohms nominal for both input and output. Nominal cutoff frequency is 1.27

CERAMIC MAGNET MATERIAL

"Cromag," a ceramic permanent magnet material, is fabricated by powder metallurgy methods which are ad-

CALENDAR of Coming Events

AUGUST 19-21 — Western Electronic Show and Convention, Civic Auditorium, San Francisco, Calif.

SEPTEMBER 1-3 — International Sight and Sound Exposition, Palmer House, Chicago, Ill.

SEPTEMBER 21-25 — Eighth National Instrument Exhibit, Hotel Sherman, Chicago, Ill.

SEPTEMBER 28-30 — National Electronics Conference, Hotel Sherman, Chicago, Ill.

OCTOBER 5-8 — Fall Technical Meeting of USA and Canadian National Committees of URSI and the IRE Professional Group on Antennas and Propagation, National Research Council, Ottawa, Canada.

OCTOBER 26-28 — IRE-RTMA Radio Frequency Meeting, Toronto, Ontario.

no pressing in a wide variety of late shapes with no machining necessary. It can be supplied in long tubes, and square, rectangular, or symmetrical shapes by *Henry L. Hey & Company, Inc.*, West Orange, N. J., and is applicable in various fields.

Lightweight and magnetically hard, Mag has exceptionally high coercive force and at the same time has a remanence induction suitable for a wide variety of applications. Its stability makes it ideal for use in applications where it must be subjected to high demagnetizing fields. In high frequency operations, Cromag shows a very low and minimum proximity effect on associated circuitry.

TRANSISTOR TEST SET

Testing the small signal behavior of point-contact and junction transistors, the Model T-61 transistor test set measures four independent parameters of four-terminal equivalent circuit of the transistor. These measurements are carried out over the complete operating range of the transistor, and lead directly to quantitative data needed for circuit design.

The Model T-61, which is being marketed by *Transistor Products, Inc.*, Snow Hill Street, Boston, Mass., contains separate metering circuits for



Applied d.c. currents and voltages, precision single-frequency audio oscillator, and a precision vacuum-tube voltmeter for direct reading of the parameters under test. Over-all accuracy is

UPPER STABILIZER

Albemarle Laboratories, Inc., P. O. Box 1578, San Diego 10, Calif., has

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Tel-Instrument Co. Inc.
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Lear, Inc.

announced the availability of the Model 122 chopper stabilizer. Having a self-contained power supply, this unit



affords absolute calibration of output voltage in prescribed steps, with a long-time stability of .01%. Short-time drift is maintained to within a few parts per million.

The "Kay-Lab" chopper stabilizer employs a unique circuit whereby a fraction of the output voltage is compared to a standard cell. A polarized signal of ± 30 volts and 5 ma. is fed to the power supply being regulated, and a precision attenuator is calibrated to provide the desired output voltage to an absolute accuracy of 0.1%.

DIRECTIONAL COUPLER

Whenever a number of television receivers or other pieces of electronic equipment are connected to the same signal source, such as a transmission line, antenna, etc., some means must be used to isolate one piece of equipment or television receiver from the other to prevent interference. The new SKL Model 427 directional coupler is designed to provide this necessary isolation between TV receivers in television distribution systems for cities, towns, apartment houses, etc. It may also be used to isolate electronic equipment that must be fed from the same source over the band of 40 to 240 mc.

Model 427 provides one 75-ohm input and two 75-ohm outputs. The directional coupler action results in an insertion loss of 3.2 db and provides an attenuation of reflections and local

oscillator interferences originating at a receiver of at least 14 db. For further information, write *Spencer-Kennedy Laboratories, Inc.*, 186 Massachusetts Avenue, Cambridge 39, Mass.

X-RAY SPECTROMETER

Now available from the Research & Control Instruments Division of North American Philips Company, Inc., 750 South Fulton Avenue, Mount Vernon, N. Y., is a Norelco 90° Geiger-counter x-ray spectrometer for use in research and educational fields as well as for production control.

Designed to provide a full standard range of operation, this instrument employs a long-life air-cooled x-ray tube and a goniometer having a radius of 130 mm. Angular range is -10° to $+90^\circ$ (two theta); angles can be read directly from a dial or from a strip chart. The Geiger-counter position is continuously readable to 0.01° (two theta) over the full range.

The high output x-ray generator provides fixed operation at 35 kvp at 6 ma.; it is self-rectified for simplicity and low tube replacement cost. Voltage and current stabilizers are included.

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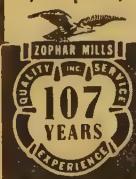
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AIRBORNE ELECTRONICS CONFERENCE

Highlights of the Dayton Conference, held May 11-13, which was sponsored by the Dayton Section, IRE, and the Professional Group on Airborne Electronics.

ATTENDANCE at the Fifth Annual Dayton Airborne Electronics Conference exceeded 2000, thus spotlighting the importance of this rapidly expanding branch of the electronics field. There were exhibits by 59 different manufacturers and representatives, and over 100 technical papers were presented.

As the subjects of "mechanized assembly" and "transistors" attracted a great deal of interest at the Conference, this report will concentrate on these two subjects rather than attempt to cover all of the topics which were discussed.

Mechanized Assembly

Printed circuits of various kinds play a vital role in any mechanized assembly process. E. R. Bowerman, of *Sylvania Electric Products Inc.*, in a paper prepared jointly with Robert F. Walton, discussed a new type of flexible plated circuit with numerous applications. This is a cloth-backed plated circuit, made by a transfer process in which a stripable copper electrodeposit and a thin polyvinyl resist are transferred to a cloth adhesive tape from a stainless steel base. The stainless steel is reusable and its surface may be patterned to identify the wiring on the unit being produced.

Another printed circuit technique, called the Placir process, was described by William J. Weisz, of *Motorola Inc.*. In this process, a Bakelite plate is formed, punched as desired, and then roughened. A resist ink is silk-screened onto the area where no circuit is desired, and the remaining surface is treated to make it conductive. Copper is then plated onto this area to the desired thickness of 1 to 3 mils. Plating takes place on the walls of all holes, forming eyelets. Components may be mounted on both sides of the Bakelite sheet, since soldering is accomplished by a touch technique. In effect, a miniature solder pot is used for each connection. *Motorola* has been using this design for a home radio receiver.

The development of mechanized assembly techniques and machinery has been undertaken by Stanford Research Institute. The current status of this program was reported by Freeman M. Hom and Edwin R. Gamson. Some of this work was described in *RADIO-ELECTRONIC ENGINEERING* (June, 1953, p.

32) in connection with a report on the Cincinnati Television Conference. Further details were presented on such factors as the type of printed circuit to be used, suitable materials for a resist, dip-soldering techniques, recovery of copper, and means for protecting the final assembly. Although the majority of the work is being done with conventional circuit components, plans are under way for developing components to be used specifically in mechanized assembly processes.

Subminiaturization techniques were discussed by A. H. Drayner, of *Consolidated Vultee Aircraft Corporation*, in a paper prepared jointly with J. R. Allen. A specific project, namely, a servo amplifier, was reviewed in some detail. It was brought out that the use of subminiaturization and printed circuit techniques not only reduces size and weight, but can greatly reduce costs, improve performance, and make servicing easier.

Transistors

"How the Transistor Changed Our Thinking" was the subject of a paper presented by Ottmar M. Stuetzer, Wright Air Development Center. He emphasized the fact that the engineer must now think in terms of holes, surface potential, diffusion, impurities, etc., and must become familiar with such devices as the hook transistor, tetrode, analog transistor, transstristor, fieldistor, photodiode, and photomodulator.

A rather startling development was discussed by I. Arnold Lesk, of *General Electric Company*, in a paper entitled "Some Multi-Electrode Germanium Devices." This development is somewhat similar to that utilized in the *Bell Laboratories* "tetrode" junction transistor, but is applied to alloy junctions rather than grown junctions. Mr. Lesk placed one or more alloy junctions on each side of the basic germanium bar, and then polarized the bar by means of a d.c. potential of about four volts. Since the resistance of the germanium was from 1000 to 10,000 ohms, the actual current flowing was rather small. The alloy junctions may be placed opposite each other, or displaced, each location yielding different properties. Thus, it becomes feasible to tailor-make a transistor for practically any desired function.

The paper entitled "Some Applica-

tions of Transistors" by L. E. Flory of *Radio Corporation of America*, cited a great deal of interest and comment, partly as the result of demonstrations of transistorized equipment. Flory demonstrated a spring-wound phonograph with transistor amplification, an all-transistor personal radio, FM receiver, and an auto radio operating direct from a 6-volt battery. He also demonstrated a power amplifier stage having four transistors and a 16-ohm speaker as the only component. This amplifier uses two NPN and PNP junction transistors connected in a so-called "complementary" circuit. In addition, Mr. Flory discussed the use of transistor frequency dividers for sweep circuits—an innovation which would greatly simplify camera control circuitry—and a point-contact transistor which has been made to operate at frequencies up to 300 mc., thus opening the way for all-transistor FM and receivers.

An analysis of transistors for amplifiers was presented by James Nelson, of *Raytheon Manufacturing Company*. He concentrated on the junction type transistor because it is inherently short-circuit stable. Also, in general, it has lower base and emitter resistances and higher collector and mutual resistances than the point-contact type, these conditions being favorable for circuit operation. Mr. Nelson developed the theory for operation of amplifiers in the 500-kc. range, verified this theory reasonably well experimentally. He found that at the present time selection is necessary in order to obtain transistors which will operate properly as i.f. amplifiers.

Variations in transistor small-signal and d.c. parameters were discussed very comprehensively by F. M. Dukat, also of *Raytheon*. Mr. Dukat stressed the fact that at the present stage of development no manufacturing techniques are known which can control these parameters within close limits other than by selection after manufacture. He presented a series of curves showing the spread for the various characteristics based on measurements on 100 units produced in the last quarter of 1953. This spread has already been reduced in current production, and is expected to be reduced further as more experience is gained.



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Model M-8100. The rugged PHILCO CIRCUIT MASTER is one of the finest vacuum tube voltmeters ever designed. With its companion unit the famous...

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■ Can be used with any amplifier. Intermodulation distortion virtually unmeasurable. Complete, professional phonograph equalization settings and tone controls; genuine F-M loudness control; 5 inputs and 5 independent input level controls; 2 cathode follower outputs. Equipped with finest phono preamplifier. Self-powered. Chassis, \$89.50 • With cabinet, \$97.50



FM-AM Tuner MODEL 50-R

■ Features extreme sensitivity (1.5 mv for 20 db of quieting), low distortion (less than 0.04% for 1 volt output), low hum (more than 100 db below 2 volts output.) Armstrong system, AFC with switch, adjustable AM selectivity, separate FM and AM front ends, fully shock-mounted, cathode follower output, fully shielded, etched aluminum chassis. Self-powered. \$159.50

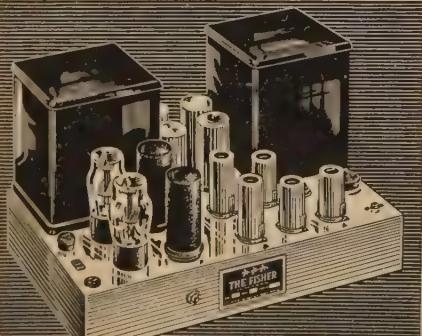
50-Watt Amplifier

■ Truly the world's finest all-triode amplifier, yet moderately priced. A man's size unit, with less than 1% distortion at 50 watts (.08% at 10 watts.) Intermodulation distortion below 2% at 50 watts. Uniform response within .1 db, 20-20,000 cycles; 1 db, 5 to 100,000 cycles. Hum and noise more than 96 db below full output. Quality components throughout. \$159.50

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ALL-TRIODE AMPLIFIER • MODEL 50-A



Within the INDUSTRY

JAMES L. BYROM has been named to the new position of director of engineering for General Dry Batteries, Inc. of Cleveland.

The position was created as part of the company's broad program to strengthen its functional organization and to expand all phases of engineering activities in producing a full line of dry-cell batteries for radios, hearing aids, etc.

Mr. Byrom was formerly vice-president and general manager of the Chandler-Evans Division of Niles-Bement-Pond Co. and prior to that served Underwood Corp. and National Carbon Co. in engineering capacities.



* * *

DR. W. R. G. BAKER, General Electric Company vice-president and general manager of its Electronics Division, has been awarded the Medal of Freedom by the Honorable Earl D. Johnson, under-secretary of the Army.

Dr. Baker was awarded the medal for accelerating the application of electronics to the solution of Army research and development problems. He led a mission of leading scientists and industrialists to Korea in the summer of 1952, to study the problem of utilizing electronic devices and principles to the maximum extent in modern war, thereby increasing the effectiveness of the individual soldier and reducing the cost of human life.

* * *

LEO G. SANDS has been appointed to the post of sales manager of Langevin Manufacturing Corporation of New York.

Mr. Sands recently resigned as president of Bogue Railway Equipment Division, manufacturer of railway electrical and communications equipment. He had also served Bogue Electric Manufacturing Company as general sales manager.

In his new position, Mr. Sands will make his headquarters at the company's main offices at 37 West 65th Street, New York City.

* * *

RUSS DIETHERT of the Chicagoland Chapter was unanimously elected national president of "The Representatives" at the organization's annual delegates' meeting held recently in Chicago. Norman B. Neely of the Los Angeles Chapter was the retiring president.

Wally B. Swank of the Empire State Chapter was named first vice-president, Dean A. Lewis of the California Chapter was elected second vice-president, and Ross Merchant of the Wolverine Chapter, third vice-president.

Ronald G. Bowen of the Rocky Mountain Chapter was elected international secretary while George Peck of the Chicago Chapter was named national treasurer.

Mose S. Branum of the Southern Chapter was elected to serve on the board of governors for a three-year term.

* * *

EDWARD L. NUNG, formerly manager of the Long Island City parts division plant of Sylvania, has been named manager of the tuner division of P. Mallory & Co., Inc. of Indianapolis.

DONALD H. KUNSMAN is the new vice-president of the RCA Service Company. He will be in charge of the consumer products service division.

CBS-Columbia, Inc. has appointed LOUIS HAUSMAN to the post of vice-president.

The firm is the television and radio receiver manufacturing subsidiary of the Columbia Broadcast System, Inc. . . . C. J. HARRISON has been named to the newly-created post of marketing manager for the television transmitter division of Allen-Du Mont Laboratories, Inc. He will supervise field sales activity, order administration, the division's advertising and publicity program, as well as coordinate all contract processing . . .

WIN I. GUTHMAN, head of one of largest independent coil manufacturing companies in the country, died recently of a heart attack. He was 65 years old at the time of his death. He was the president and founder of Edwin I. Guthman Co. of Chicago. General Electric Company's tube department has named GRADY L. ROBERTS to the post of manager of market with headquarters in Schenectady.

LEONARD L. ROSENFIELD has been named production manager of Jerry Electronic Corporation. He was formerly chief industrial engineer in Joliet, Ill., plant of the F. W. Sibley Division of General Instrument Co.

WEBSTER E. BARTH has been appointed general sales manager of Pointe Electronics Inc. In his new post he will coordinate the sales efforts of all of the company's divisions.

* * *

THE MAGNETIC RECORDING INDUSTRY ASSN. has been recently formed by a majority group of the leading recording manufacturers in the United States.

The meeting to discuss the formation

ONLY TELCO UHF ANTENNAS HAVE THE "WISHBONE"



UHF

"WISHBONE" HIGH DI-ELECTRIC INSULATOR

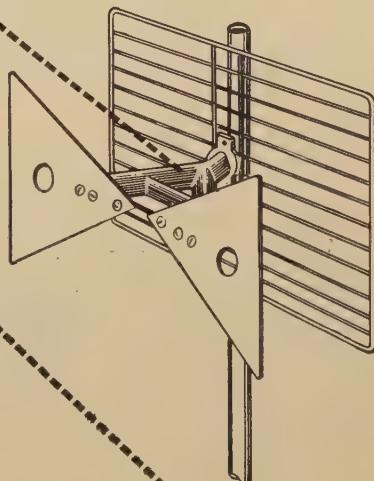
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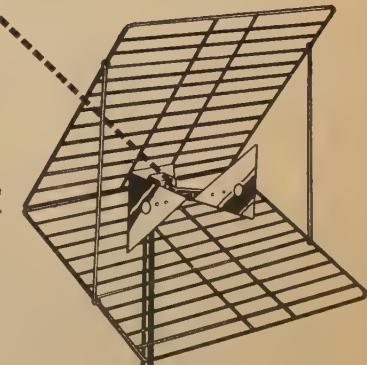
STRONG . . .
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MECHANICAL
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THAT'S RIGHT . . . Only TELCO'S got this remarkable new free air insulator . . . the "Wishbone" . . . that absolutely prevents shorting out under any conditions. Sturdy vibration-proof reflector and rugged aircraft aluminum elements are fastened to the "Wishbone" to prevent vibration and shaky pictures. Antenna performance is proved by actual UHF field testing . . . assures high gain on all channels. Better buy TELCO . . . your all-ways best UHF Antennas!



No. 8965—Butterfly
Wishbone Antenna,
complete with
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THE HEATHKIT Dual RECORD PLAYER KIT



MODEL RP-1

\$59.50

SHIPPING
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Shipped
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Only

- Dual matched speakers for room filled perimeter sound
- Plays all record sizes, all speeds
- Newly developed ceramic cartridge
- Automatic shut off for changer and amplifier

Here is a new introduction to quality record reproduction. A simple to operate compact table top model with none of the specialized custom installation problems usually associated with high fidelity systems. Two matched speakers mounted in an acoustically correct enclosure reproduce all of the music on the record. Reproduction with the unique sensation of being in a halo of glorious sound.

The world famous VM Tri-O-Matic record changer plays all three record sizes at all three speeds. Automatic shut off for both changer and amplifier after the last record is played. A wide range ceramic cartridge features an ingenious "turn-under" twin sapphire stylus for LP or 78 records without turning the cartridge. Simplified easy to assemble four tube amplifier featuring compensated volume control and separate tone control. Proxylin impregnated fabric covered cabinet supplied completely assembled. You build only the amplifier from simple step-by-step instructions. No specialized tools or knowledge required.

The Heathkit Dual Kit includes cabinet, VM player, speakers, tubes, and all circuit components required for amplifier construction. If a kit project has ever tempted you, here is the perfect introduction to an interesting and exciting pastime. Build the Heathkit Dual and enjoy unusually realistic room filling reproduction of fine recorded music.

OTHER Famous HEATHKIT AMPLIFIERS

THE HEATHKIT 6 WATT AMPLIFIER KIT

Model A-7B

\$14.50

Ship. Wt. 10 lbs.

The Heathkit Model A-7B Amplifier features separate bass and treble tone controls — two compensated inputs — three output impedances 4, 8, and 16 ohms — frequency response $\pm 1\frac{1}{2}$ db from 20 to 20,000 cycles — push pull beam power output at full 6 watts.

Heathkit Model A-7C with preamplifier stage..... **\$16.50**

HEATHKIT High FIDELITY AMPLIFIER KIT

\$35.00

Model A-9A
Ship. Wt. 17 lbs.



A 20 watt high fidelity amplifier especially designed for custom installations. Low hum and noise level 9 pin miniature dual triodes in pre-amplifier and tone control circuits. Four switch selected inputs. Frequency response ± 1 db 20 to 20,000 cycles. Output impedances of 4, 8, and 16 ohms.

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called by Joseph F. Hards, vice-president of *A-V Tape Libraries Inc.* manufacturers and firms manufacturing related tape recording equipment unanimously to form the association.

Tape recording manufacturers attending the initial meeting included *Ampex Electric Corp.*, *Audio Devices Inc.*, *Bell Sound Systems*, *Brush Electronics Co.*, *Crestwood Recorder Division of the Daystrom Electric Co.*, *Dukane Corporation*, *Fidelitone*, *Magnecord Corp.*, *Minnesota Mining and Manufacturing Co.*, *ORR Industries, Inc.*, *The Pentron Corporation*, *Webster-Chicago Corp.*, *Webster Electric Co.*

Mr. Hards was elected president *pro-tem*. An organizing committee has been appointed to outline the purpose and functions, and to draw up the laws of the association.

* * *

EUGENE F. PETERSON has been appointed manager of marketing *General Electric Company's* radio and television department.



He was formerly manager of marketing for the company's tube department with headquarters in Schenectady. He will now be located at the Electronics Park plant in Syracuse.

Upon graduation from college, after serving a year as a professor of physics at Sterling College, Mr. Peterson joined the *G-E* test engineer program in 1933. He joined the Test Department in 1934 and completed the company's advanced course in engineering in 1936.

He has served in various engineering and supervisory capacities at the company's Schenectady and Owenton, Ky. plants. He was named manager of marketing for the department in 1951.

* * *

MILWAUKEE SCHOOL OF ENGINEERING recently celebrated its 50th anniversary with a banquet attended by students and civic dignitaries.

Founded in 1903 by Oscar Werwath, the school has grown until today has an annual enrollment of 1500 students and 350 evening students. Nearly 50,000 students have received training at the school since 1903.

Karl Werwath, son of the founder, assumed the presidency upon his father's death in 1948. Another Heinrich M. is controller and treasurer.

* * *

MOTOROLA, INC. of Chicago is currently celebrating its 25th year in the electronics field.

Founded in 1928 as *Galvin Manufacturing Company* by Paul V. Galvin, the firm had six employees and a capital fund of \$565. The company, now *Motorola, Inc.*, has since grown

(Continued on page 105)



Fig. 1. Over-all view of the 16 mm television film projector designed and built by Radio Corp. of America.

IT IS an obvious conclusion that motion picture films are destined to play an increasingly important role in the future of television. To effectively demonstrate their products at lower cost and at the same time maintain standards comparable to live audio pick-up, alert business executives are turning towards the medium of film advertisement.

An ever increasing footage of commercial film flows daily out of processing laboratories. Kinescope recordings in New York City alone, according to a well-known trade publication, reach 2,000,000 feet per week. The techniques of laboratory quality control are most rigid wherever television is directly concerned.

Today phrases like "gamma," "print density" and "tonal gradation" appear in conversation with TV broadcast engineers. It would seem that a sweeping technical revolution is slowly taking place, wherein tomorrow's technician must not only be well versed in electronics but in the art of photography as well. Some of the larger advertising agencies, as a matter of fact, employ skilled consultants whose job is to integrate the medium of film to that of television.

In lieu of moving pictures, advertisers will often employ pictorial stills or "telops" as they are sometimes called. (Fig. 2) These may be similar to standard 4x5 photo reproductions. In other cases a slide transparency may be used. Various effects such as dissolves, superimpositions, and even

FILM FOR TV

By
HENRY J. SEITZ, S.M.P.T.E.

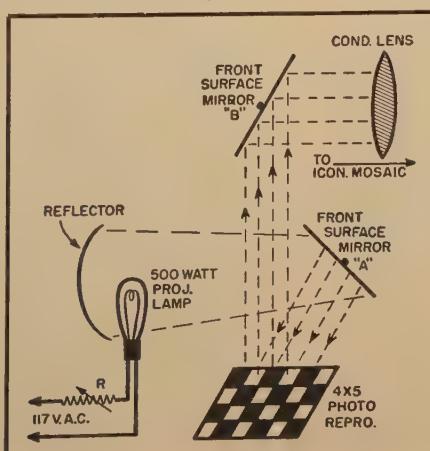
As production costs continue to spiral, more and more of your favorite TV programs will come to you on film.

emergency transmission of the TV station's test pattern can be achieved by using either of these devices. A dissolve-to-black, for instance, may be obtained by slowly cutting off the 500-watt lamp filament supply. (See Fig. 2)

Kinescope recording or the filming of moving pictures from the face of a special CRT offers unlimited horizons. In effect it conveniently satisfies the U.S. time zone differences. A hit show that begins at 8:00 p.m. New York time will hardly be acceptable to Californians, where it is only five o'clock in the afternoon. By kinescoping the live show and presenting it over the station's film facilities later in the evening, the sponsor's product is thereby advertised to a West Coast audience.

As an effective transducer for converting film images into their electrical equivalent, the iconoscope (Fig. 3) is presently among the most popular. Its grey scale response has a curve that closely approximates that of the average home television receiver. Furthermore film camera control operators favor the "Ike" because video gain riding is reduced to two major operating controls, namely, gain and pedestal. (Fig. 9)

Fig. 2. How the "telop" device is used to transmit static images in television work.



In this fashion shading problems are reduced to a minimum and necessary critical adjustments can be performed quickly and effectively. Except for ordinary routine maintenance, the iconoscope requires little attention once it has been correctly aligned.

Modern innovations like edge- and back-lighting, have reduced to a minimum certain drawbacks that were prevalent when iconoscopes were first employed. Many old time viewers will undoubtedly recall the anguish experienced whenever their celluloid hero disappeared into the flare at the viewing tube's edge, only to emerge later showered by secondary electrons. In those days the "Ghost Rider" really lived up to his name.

Before proceeding any further, certain basic characteristics of film might well be investigated. For example, an outdoor scene may register a brightness contrast (the ratio between the brightest and darkest values) of 150 to 1 or higher between the bluish light of the sky and the darkest of shadows. The human optical mechanism accounts for an adaptation of about 100 to 1. A theater-type motion picture projector is capable of yielding a screen brightness of 40 to 1. With home TV receivers approximating only 25 to 1, it can readily be seen that film quality is of paramount importance.

To effectively reproduce a good grey scale or tonal gradation between the highlights and shadows, print density should conform to certain basic standards. This, in turn, depends upon a sequence of factors that may well include (a) the photographic negative original; (b) laboratory processing, and (c) the final printing. Whether 16 or 35 mm, if the release or final print is able to reproduce many delicate shades of grey, it is called "low contrast" film.

On the other hand, films of "high contrast" (contrasty) are extremely black and white. Having little or no grey scale, the end result is a rather harsh picture and one lacking in fine detail. The measure of contrast is in-

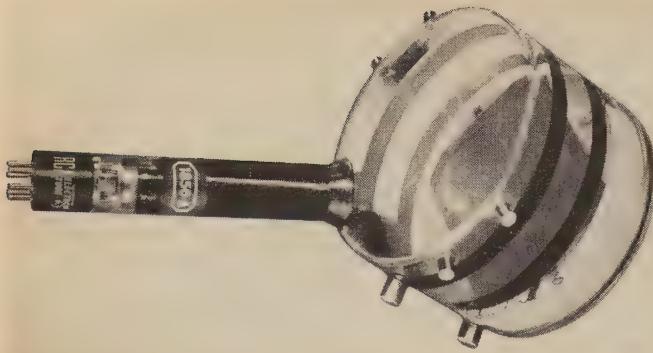


Fig. 3. Over-all view of RCA's Type 1850A iconoscope tube.



Fig. 4. RCA's 5WP11 transcriber kinescope for TV film work.

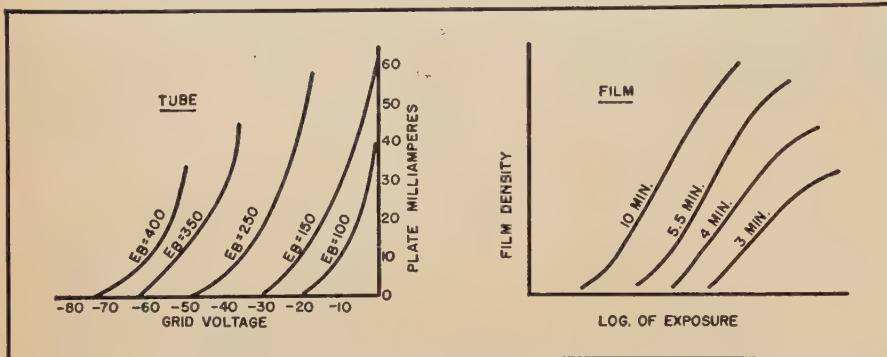


Fig. 5. Demonstrating the similarity between tube and film characteristic curves.

dicated by the letter γ (gamma) of the Greek alphabet.

Film also possesses its own series of characteristic curves remarkably similar to those of vacuum tubes with which we are all familiar. (Fig. 5) However, instead of E_g , E_b being the determinant factors, sensitometry makes use of the relationship between the two variables, exposure and density. Since tubes fall into specialized

groups (sharp cut-off, high μ , etc.) it conveniently follows that many types of film stock having countless variations (coarse grain, fine grain, slow speed) are also obtainable.

It can readily be seen that any decrease in light transmission caused by dense or contrasty film, will tend to limit iconoscope action to the lower portion of its own characteristic curve. (Fig. 11) Consequently flare, graini-

ness, and noise have a tendency to be accentuated. Noise acts to prevent the transmission of higher frequencies, so necessary to a sharp, snappy picture.

Obviously the best means of overcoming noise is to maintain a high signal-to-noise ratio. In the *RCA* unit preamplifier special attention is given to the critical film camera input stage. A *Western Electric* 417A dual miniature triode is used. The transconductance (G_m) of this amazing little tube is about 25,000. If we remember our musty classroom text ordinary run-of-the-mill triodes fall within a range of only 200 to 500 micromhos!

This tube, when used as a cascade type input feeding a 6J6 output (Fig. 8), vastly enhances iconoscope performance. The over-all gain is about three times that of the earlier 6AK5 which was 8. The heater operation is d.c. In addition, low inductance bypass condensers are inserted in the filament circuits. Sixty-cycle problems are thereby eliminated.

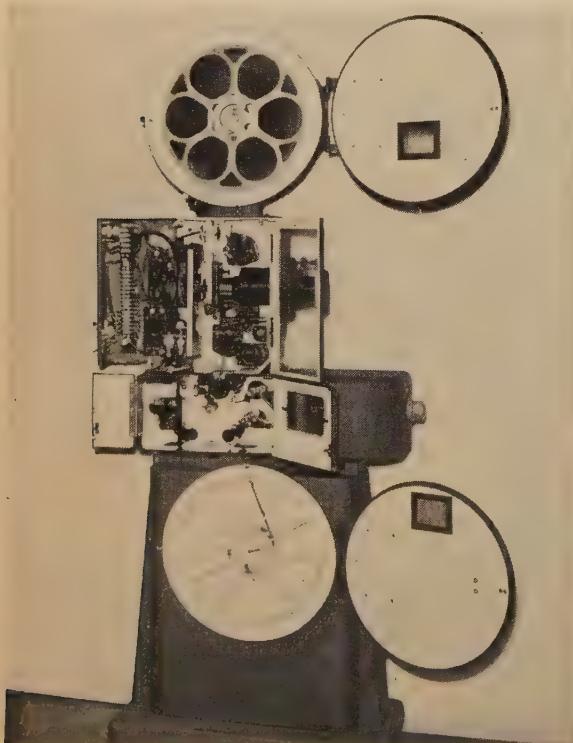


Fig. 6. Radio Corporation of America's TP-35B 35 mm television film projector unit. The intermittent is a three-sided Geneva movement driven by a specially-designed synchronous motor.

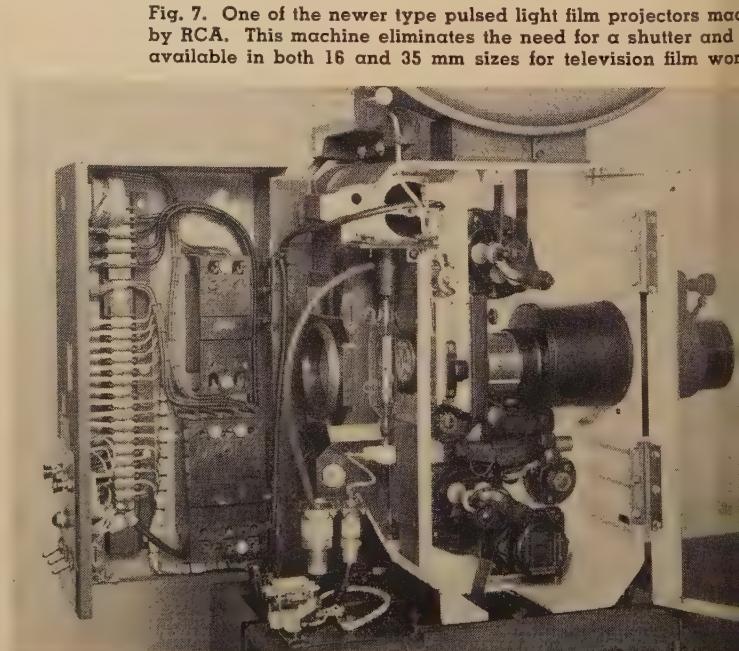


Fig. 7. One of the newer type pulsed light film projectors made by *RCA*. This machine eliminates the need for a shutter and is available in both 16 and 35 mm sizes for television film work.

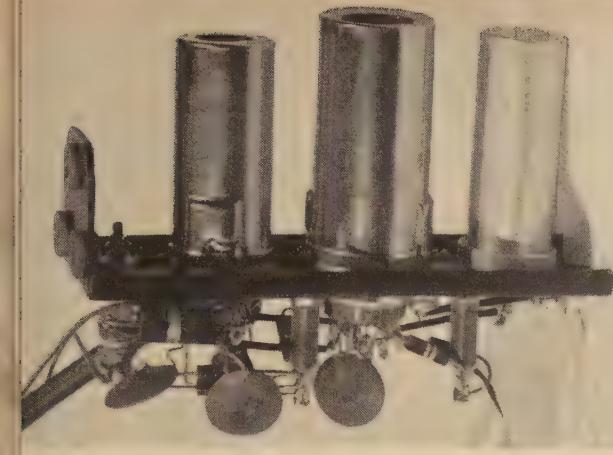
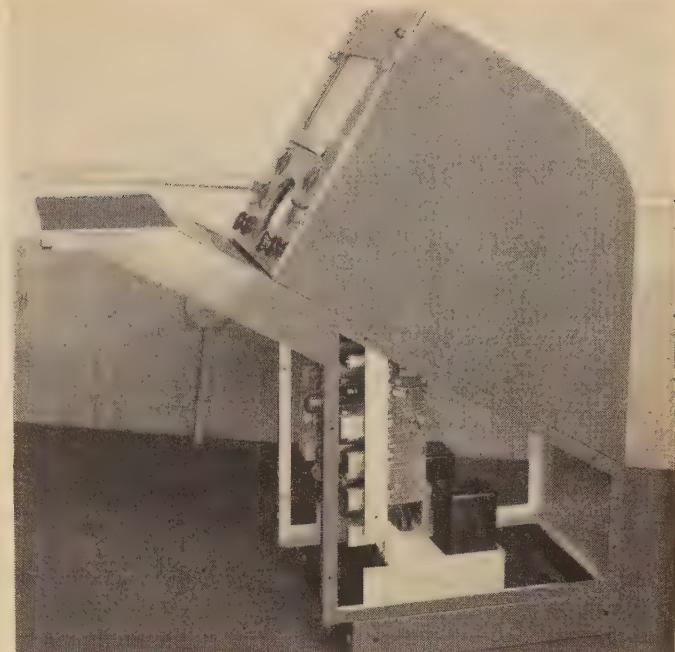


Fig. 8. Cascode preamp using the W.E. 417A (the middle tube).

Fig. 9. RCA's new TK-20A film camera control which consists of a console desk section with a control chassis mounted in lower compartment and camera monitor mounted in upper part. A picture amplifier fed by the preamp in the camera, pulse line amplifiers which feed driving signals from the studio sync generator to the camera and monitor, shading signal generators, and several associated camera controls are included in chassis.



Since no subject is more frequently misunderstood, the conversion of moving picture film rate to conform to television standards requires some explanation. Fortunately a standardized projection rate of 24 frames or pictures-per-second holds for both the 8 and 35 mm systems.

In most 16 mm systems (Fig. 10), the projected light illuminating the film is momentarily interrupted by a notched rotary disc called the shutter. This permits the projector's film pulldown mechanism to operate while the screen is dark. Since the next successive film frame now rests in the film aperture, the intense light beam will easily pass through it whenever the notch and beam coincide.

In effect, each frame is projected either two or three times. However, since the entire action takes place in such a rapid sequence, (7.2 inches-per-second for 16 mm) the eye is tricked into believing that it sees a continuous motion of fast moving images.

Since the frame rate for television is 60 fields interlaced to produce 30 complete pictures-per-second, some means must be utilized to compensate for existing frame differences. Standard projection rates, as it was previously mentioned, consist of 24 frames-per-second. We have, therefore, a ratio of 5 to 4 to satisfy. In other words two frames of motion picture film will require the same amount of time as five TV fields or .5 TV frames. Therefore by flashing and scanning one film frame twice and the other three times, the difference in frame rate is conveniently satisfied.

Moving pictures consist of a series taken at a 24 frame-per-second rate. Each frame pauses a fraction of a second while being exposed. Conversely, the same principle applies in projection. Television film projectors, on the other hand, employ an intermit-

tent movement. Film advancing mechanisms in the latter type are categorized as 2 to 3 intermittents.

In the *RCA TP-35B* (Fig. 6) the intermittent is a three-sided Geneva movement driven by a synchronous motor. This pulls the film down at unequal time intervals (2:3). Thus a combination of mechanical motion plus iconoscope storage and scanning synthesizes to produce television moving pictures—a tribute to engineering ingenuity.

In a typical TV 16 mm system, (Fig. 1), a rotary shutter synchronized at 3600 rpm interrupts the projected light 60 times per second. The shutter is so designed that each flash lasts 1/1200th of a second. By accurately timing these flashes and causing them to fall within the system's vertical blanking period of 1270 microseconds, we impress upon the iconoscope's mosaic information which is then scanned and converted into a video signal.

As will be seen from Fig. 12 these intense bursts of light occur only before or after pulldown. In effect this prevents "travel ghost," a most unpleasant phenomenon, caused by nonsynchronous action in the projector's shutter operation. The newer type of pulsed-light machine eliminates the need for a shutter and is available in both the 16 and 35 mm sizes (Fig. 7).

These light flashes coming from the projection lamp must at all times coincide or "lock-in" with the system's vertical blanking interval. Accurate synchronism is maintained by using a common source of a.c. for both the TV station's sync generator and the film projector motors. In addition synchronous type motors are used throughout.

Television recording or the transcribing of images by photographic means sounds complex, however when reduced to its basic fundamentals it

practically amounts to no more than a reversal of preceding film techniques. Instead of 24 film frames being converted to 30 pictures-per-second we now work backwards to convert 30 TV pictures to 24 film frames.

The cathode-ray tube, a 5WP11, from which the pictures are taken is one of high resolution and short persistence (Fig. 4). In comparison

(Continued on page 130)

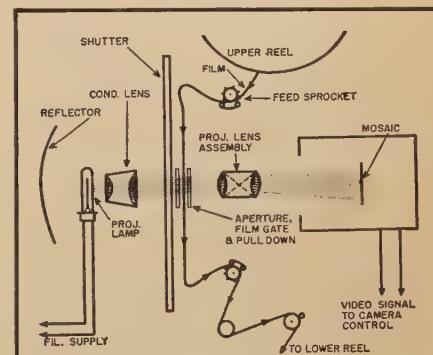
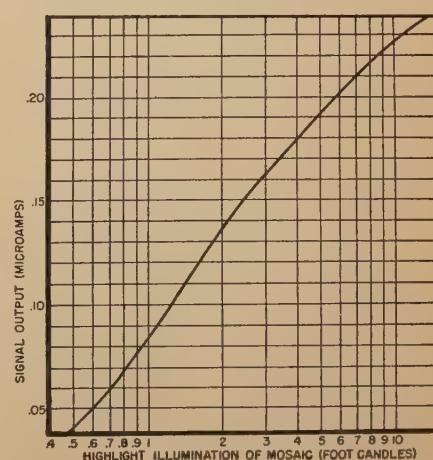


Fig. 10. Typical 16 mm TV-type film projector.

Fig. 11. Iconoscope characteristic curve (1850A).



A SIMPLE ANTI-FLUTTER CIRCUIT

By JOHN K. FRIEBORN

MANY television set-owners have no idea what the effects of airplane flutter look like. A few, who live near airports, hardly know what a television picture would look like without these effects—unless their receivers contain some circuit to reduce them. Most recent American television receivers incorporate automatic gain control circuits which are "keyed" specifically to reduce one of the effects of airplane flutter. Keyed a.g.c. circuits are relatively complex; they require the addition of one tube and several other components to the receiver. Recent 21-inch HMV (British) television receivers use a simpler circuit which accomplishes about the same thing.¹ The fact that the circuit and several related ones are covered by a 1951 British patent² may or may not account for the fact that nothing of the sort seems to have been used by any American manufacturer in place of a keyed a.g.c. circuit.

Airplane flutter is the name given to the combination of effects on the television picture when a signal reflected from a moving aircraft is combined in the receiver with the direct signal from the station. There are two main effects: first, a "ghost" picture is produced and second, there is a fluctuation in the over-all average brightness of the screen. By using an extremely directional antenna, both effects can be reduced, unless the aircraft is nearly the same direction from the receiver as the transmitter. If a sufficiently directional antenna is impractical, appropriate receiver circuits can at least reduce the amount of brightness fluctuation.

A reflected signal may be in-phase with the direct signal and add to it or out-of-phase and subtract from it. The exact phase relation will depend upon the difference between the times taken by the signal to travel over the direct and reflected paths. If the time difference is exactly enough to allow the r.f. signal to complete a whole number of cycles, the two signals will be in-phase, although they may have slightly different instantaneous modulations. The modulation of the reflected signal, which travels for the longer time, corresponds to an earlier part of each line in the original

This simple British TV circuit may be used in U.S. receivers to eliminate airplane picture flutter.

picture. Therefore, the modulation corresponding to a certain point on the original scene appears later (that is, farther to the right) in the ghost image than in the direct signal image. If the time difference between the two paths is exactly enough to allow a whole number of cycles of the r.f. signal and one-half cycle more, then the signals are out-of-phase and the resultant is generally (neglecting difference in modulation) less than the amplitude of the direct signal alone.

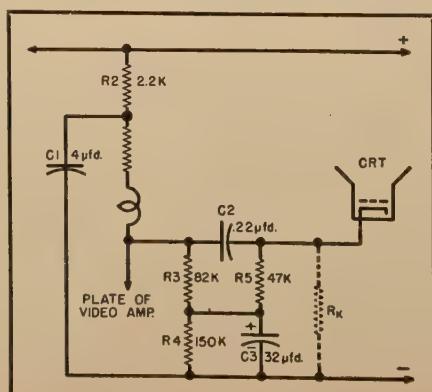
If the signal is reflected from a moving object, such as an airplane, the combined amplitude is increased, decreased, and then increased again, possibly several times. This variation in signal strength results in a variation in the brightness of the reproduced picture on any receiver which can follow these changes in the d.c. component of the video signal. The frequency of the brightness fluctuations depends upon the speed of the aircraft, its position and direction of flight with respect to the transmitter and receiver, and the frequency of the r.f. carrier. A typical range of frequencies under

different conditions and on different v.h.f. television channels is from 0.1 to 40 cycles-per-second. The most rapid variations are masked by the persistence of the picture tube phosphor and persistence of vision of the eye, while the slowest variations are not particularly objectionable. The frequency range of objectionable fluctuations may be from approximately 0.5 to 10 cycles-per-second.

Since the fluctuations in brightness are caused by variations in signal strength, one obvious solution to the problem is to keep the signal strength constant by means of an automatic gain control circuit. It should be noted that it is the peak amplitude of the signal which is kept constant by an ideal a.g.c. circuit, so that variations in the average signal strength due to variations in the average brightness of the original scene are reproduced at the receiver. Compensation for such rapid variations in signal strength as those caused by airplane flutter requires a short time constant in the automatic gain control circuit. However, the shorter the time constant in the a.g.c. circuit, other things being equal, the more the circuit is affected by noise. One method of reducing the effect of noise while retaining the short time constant is to key the a.g.c. circuit on for short periods of time and key it off for long periods in between. A keyed a.g.c. circuit is, of course, affected only by the noise which occurs during the small fraction of the total time when it is keyed on. Keyed a.g.c. is an effective solution to the problem of airplane flutter (or at least to the brightness-fluctuation part of the problem), but it is complicated.

A different approach to the problem is based on the fact that the fluctuations in brightness are, in effect, spurious video signals of very low fre-

Fig. 1. Partial schematic of the British HMV 21-inch receiver showing the anti-flutter circuit described in the text.



encies. One simple way to eliminate these very low video frequencies is by using capacitive coupling in the video amplifier and omitting d.c. restoration. This method has two related disadvantages: first, the average brightness is the same for every scene, regardless of what it was originally and second, with the average brightness constant, the blanking level varies, so that additional blanking circuits are necessary to keep the trace lines from becoming visible occasionally.

The method used in the HMV receiver mentioned at the beginning of this article reduces the d.c. component about 50%, but it reduces the amplitude of the most objectionable flutter frequencies much more. A partial schematic diagram of the receiver is shown in Fig. 1. This circuit provides a boost of extremely low-frequency and d.c. components of the video signal in the plate circuit of the video amplifier, by means of R_2 and C_1 , then two separate paths for the video signal from the video amplifier plate to the picture tube cathode. The a.c. components of the signal (frequencies from 50 cycles up, under the British standards) are transmitted through C_3 without much loss. The d.c. component is boosted almost 50% by R_2 , then applied through R_3 , R_4 , and C_4 to R_5 , the cathode input resistance of the picture tube. The net transmission is said to be about 55%, which would mean a value for R_5 of about 10,000 ohms. At one cycle-per-second, the transmission via both paths is reduced so that the combined transmission is only about 9%. The overall transmission characteristic is approximately as shown in Fig. 2. This graph shows that the attenuation is considerable over the entire band of frequencies involved in airplane flutter.

A theoretical disadvantage of the circuit of Fig. 1 is that very rapid changes in the average brightness of the original scene would not be realistically reproduced, but such rapid changes hardly ever occur. Probably most people living near airports would be willing to sacrifice perfect reproduction of an occasional lightning flash on a television program in order to have a simple method of reducing airplane flutter.

Many American television receivers which do not have keyed a.g.c. could be modified to incorporate anti-flutter circuits of this type. Several observations can be made which would have some "cut-and-try" time for experimenters wishing to make such modifications.

First, since the circuit is basically a bandstop filter, it may be thought that circuits such as the Wien bridge, the bridged-T, or the parallel-T would be better, since they give almost no output at all at their null frequencies, whereas the original circuit does transmit 9%. The greater attenuation might be desirable, but these circuits have bandwidths less

than the one in Fig. 1, so that they may not be effective over as wide a range of flutter frequencies. Also, they require more components.

Second, the original circuit was found to be satisfactory in a receiver tuned to the London television channel, a frequency of less than 50 megacycles. The highest American v.h.f. channel being more than four times as high in frequency, American receivers could be subject to flutter frequencies more than four times as high as those for which the original circuit was found to be effective. The best compromise for all of our channels probably would be obtained with a time constant approximately twice as high as the original, that is, a frequency of maximum attenuation of about two cycles-per-second, instead of one.

Third, it may be desirable to transmit the d.c. component without the 45% loss. This can be done by increasing the values of R_2 and R_4 in Fig. 1. The limit of increasing R_4 would be to make it infinite (that is, an open circuit—omit it altogether). We would still have some resistance effectively in parallel with C_4 , the leakage resistance of the condenser, which would reduce the d.c. component of the video signal slightly.

Fourth, if the anti-flutter circuit is used in a receiver which has d.c. reinsertion, it must follow the d.c. re inserter; otherwise, the d.c. re inserter will cancel out the effect of the anti-flutter circuit. This fact makes it a bit difficult to use the circuit in receivers which have any type of d.c. re-insertion except that based on video amplifier grid-leak bias.

Fifth, the effects of the resistors in the network on the d.c. potentials on the picture tube must be taken into account and compensated for if necessary.

Sixth, the values of the components must be suitable to the impedance level at the point in the receiver where the circuit is to be inserted.

Seventh, the wiring must be carefully done in such a way as to add a minimum of shunt capacitance to the video circuit, as excessive added capacitance would disturb the original high-frequency compensation.

Two typical examples of receivers which can be modified to include this

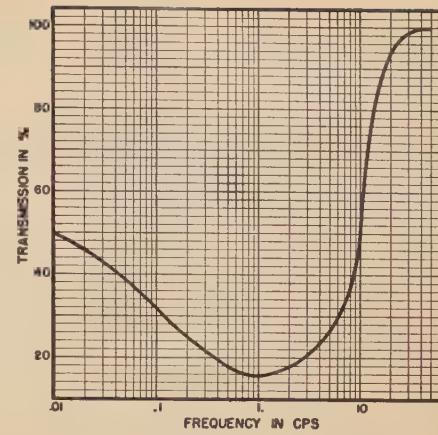


Fig. 2. Low-frequency transmission characteristic of the circuit in Fig. 1.

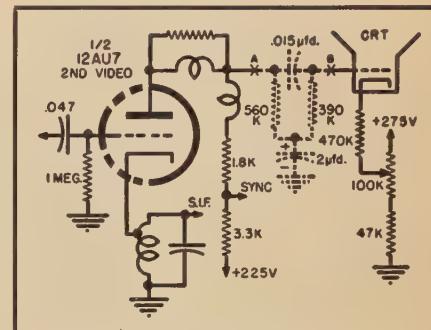


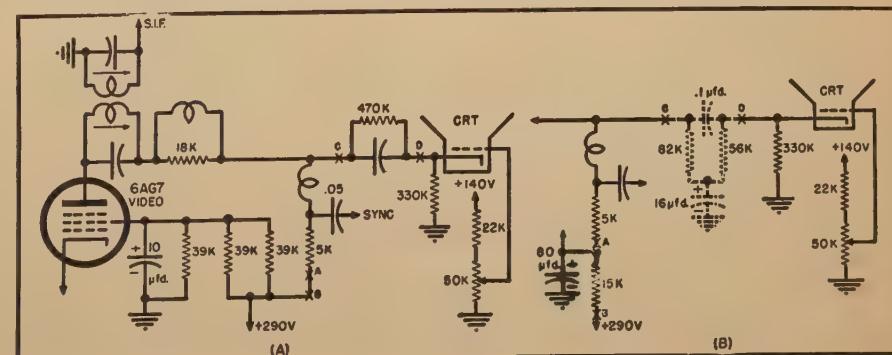
Fig. 3. Partial schematic of the Majestic Series 106 TV receiver showing (dotted) the modification to eliminate flutter.

anti-flutter circuit without too much difficulty are shown in Figs. 3 and 4. The component values given in the modified circuits are tentative and may have to be adjusted in a particular receiver to restore the original picture tube potentials or to give maximum reduction of the flutter frequency which is found most troublesome in a particular location.

The Majestic Series 106 TV receivers use a diode a.g.c. circuit, grid-leak bias d.c. re-insertion, and grid drive to the picture tube. Modification of this circuit consists simply of inserting the new components between the peaking coils and the grid of the picture tube, see Fig. 3, paying attention to the caution about wiring capacitance given previously.

Fada TV receiver Model S7C20 uses
(Continued on page 78)

Fig. 4. (A) Original video circuit of the Fada Model S7C20 TV receiver. (B) Anti-flutter modified circuit showing additions required to maintain circuit voltages.



CHOOSE THE PROBE TO FIT THE TEST

By
ART LIEBSCHER *

IN THE servicing of modern electronic devices, accuracy of measurement is the prime requisite for fast, positive analysis of circuit performance.

Under ideal circumstances, a test instrument would measure the full voltage in any electronic circuit. The instrument would have infinite input resistance and zero shunt capacitance; therefore, it would not cause any detuning, produce any alteration of waveform, nor develop any other detriment to normal operation of the circuit being tested.

From a practical viewpoint, however, it is well recognized that the contact of any measuring device has its immediate effects on the operation of an electronic circuit. Depending on the type of circuit being tested, the actual degree of this effect may vary from negligible shunting to susceptibility to the very approach of a test prod.

While some small amount of power from the circuit must be shared with the resistive input of the testing facilities, those facilities which hold power-sampling requirements to a minimum consistent with stability and accuracy most nearly approach the "ideal." Where high-frequency circuits are concerned, the detuning caused by test prod and cable capacitance is often more serious than the resistive loading problem. Together, these problems so complicate the measurement of electronic circuits as to require complete departure from the use of low-impedance, unshielded test instruments with open-wire test leads. Coping with any one problem leads to a train of problems, each of which must be fully solved to insure accurate and stable readings.

Resistive loading can be minimized by the use of high-impedance electronic measuring instruments. The circuits in such instruments, however, are not normally designed to discriminate between all of the desired and undesired potentials to which they are subjected. Therefore, they must be shielded from extraneous electrostatic and electromagnetic fields which would introduce hum, noise, and other unwanted interference. For this reason, the majority of vacuum-tube volt-



(Left) The RCA WG-217 isolating probe for d.c. voltage measurements. (Right) Direct WG-218 unit which is used for low-frequency a.c. voltage measurement.

The scope or v.t.v.m. probe you select will affect the test results obtained. Here are pointers on choosing the right one.

meters and oscilloscopes are equipped with metal cases. But the problem of shielding does not end with the case alone, for there must be an electrical link between the point of circuit measurement and the test instrument. This link, in the form of a test lead, must also be shielded. If the test lead is viewed as an extension of the electronic measuring circuit contained in a shielded test-instrument case, the logic of shielding the test lead right up to the tip of the test prod becomes obvious.

Unshielded test leads are sometimes responsible for obscure effects which hinder measurement accuracy. A test lead often acts as an antenna in picking up the signal from one circuit and re-radiating it to another circuit in the device being tested. In this way cross-coupling is established between normally shielded sections of a receiver or other electronic device, even to the extent that regeneration or oscillation occurs.

Although test-lead shielding serves to exclude interference, it increases circuit loading at high frequencies because the capacitance of the shielded wire lowers the effective input impedance of the measuring instrument. However, the capacitance added by the shielded lead is fixed and remains unchanged irrespective of the position or movement of the lead.

The effect of added capacitance can be removed and the smaller loading effect characteristic of open-wire test leads restored through the use of a low-capacitance test probe in conjunction with the shielded lead. The reduction in capacitance, however, is accompanied by a loss in signal voltage entering the test instrument. Low-capacitance probes, therefore, are designed to increase the input resist-

ance of the test instrument. When the signal loss in the probe is regained by amplification in the test instrument, the desired qualities of high input impedance, freedom from interference, and minimum circuit loading are obtained.

Probes, originally used as test probes and intended for convenience in handling the ends of flexible test leads, have now become housings for various circuit components. These components are often required at the point of test contact for least disturbance to the circuit and for maximum efficiency in supplying measurable currents through the test cable to the instrument. Input specifications for test instruments should, therefore, be specified at the probe, if they are to represent the true conditions of test application. Panel input terminal specifications are meaningless where test cables must be added to make use of an instrument, for it is as impractical to do without the cable as it is to hold the entire instrument against the circuit being tested.

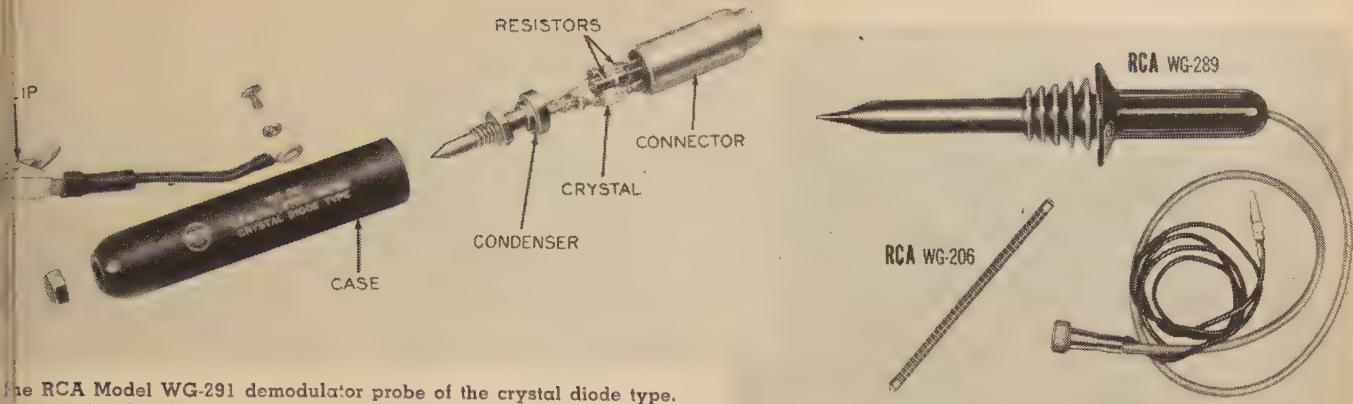
While many electronic test instruments are now equipped with shielded cables, only a few have input cables which are designed for use with a number of different probes. The RCA WG-218 direct probe and cable accommodates four varieties of slip-on probes which are now available. Having a sorted and quickly interchangeable probes is like acquiring additional instruments.

In order to become familiar with the application of various types of probes now commercially available, it is well to consider them first by function classification. The major classifications are: direct probes, low-capacitance probes, isolating probes, rectifying probes, and multiplying probes.

Direct Probes

The RCA WG-218 direct probe is

* Formerly Test Equipment Specialist, Tube Dept., Radio Corporation of America, Camden, New Jersey



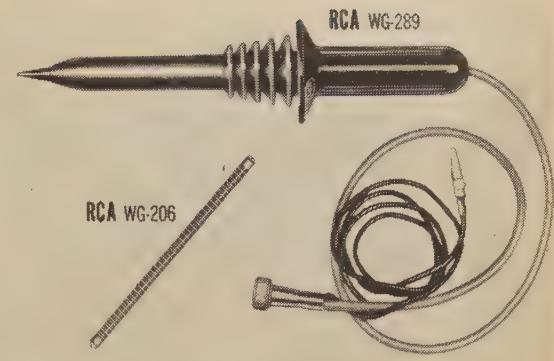
The RCA Model WG-291 demodulator probe of the crystal diode type. See text for details on the various circuit applications for this probe.

cable is a "straight-through" connection-type test probe attached to a single-lead shielded cable. It possesses the normal electrical characteristics of the cable itself. This probe and associated cable have been standardized for use with *RCA* oscilloscopes and "VoltOhmysts," their principal application being for the transfer of electrical information from a circuit (or slip-on probe) to the input connector on the instrument. When used with *RCA* "VoltOhmysts" and oscilloscopes, this cable provides an over-all input capacitance of approximately 80 μfd . Because the maximum frequency range of the cable-and-instrument combination varies inversely with the impedance of the voltage source, it is impractical to state one maximum frequency limit. In general, all low-frequency voltages, even those with complex waveforms, can be measured in both low-impedance and high-impedance circuits. Accurate measurement at higher frequencies is limited to lower-impedance circuits. The direct probe and cable cannot be used in the accurate measurement of voltages of complex waves or pulses having considerable high-frequency content because cable-capacitance loading acts to reduce those voltages. Means for reducing or eliminating the effects of this input capacitance will be discussed in connection with the following probes, most of which are designed for use in conjunction with the WG-218 direct probe and cable.

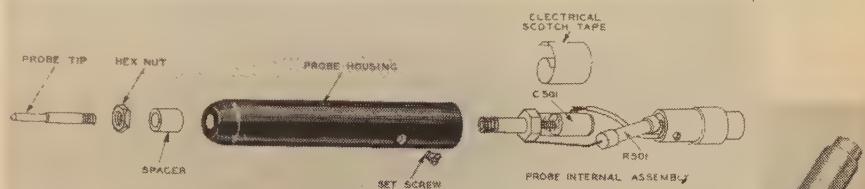
Low-Capacitance Probes

The use of a small condenser in an oscilloscope probe, connected in series with the capacitance of the shielded test lead, provides a voltage divider having very small input capacitance. This is typified by adding an *RCA* WG-216B low-capacitance probe to the direct probe and cable.

The normal capacitance of a direct probe and cable may be about 70 to 100 μfd . With selected resistance and capacitance combinations the input capacitance of a low-capacitance probe can be held to a value below 10 μfd . Low-capacitance input, however, is not obtained without some sacrifice of input signal level, because this type of



WG-289 high-voltage probe with auxiliary WG-206 unit. Latter unit is added to probe to provide required voltage division.



"Exploded" view of *RCA* WG-216B probe showing the various component parts.

probe is a voltage divider. The inherent loss in the WG-216B probe is fixed at a factor of 10 for convenience in calculating the attenuating effect when the probe is used with a calibrated instrument. Because the attenuation factor must be applied at low frequencies as well as high, the probe must be frequency-compensated for a wide response range.

Where the normal resistance of an oscilloscope is on the order of one megohm, and the small input condenser in a low-capacitance probe is shunted by a high value of resistance, the total series input resistance can be raised to 10 megohms. The combined resist-



WG-264 rectifying probe disassembled to show the various component parts.

Table 1. Quick reference chart for selecting proper probe for the job at hand.

MEASUREMENT	CLASSIFICATION	RCA TYPE	LOADING FACTOR	VOLTAGE LIMITATIONS
D.C. Voltage(V.T.V.M.)	Isolating	WG-217	11 megohms*	1500 v. d.c. max.
High-Voltage D.C. Low-Frequency A.C.	Multiplying	WG-289	1100 megohms*	50 kv. d.c. max.
	Direct	WG-218	70 μfd , 1 megohm*	1500 v. r.m.s.; 4200 v. peak-to-peak sine wave*
High-Frequency A.C. or Complex Wave	Low-Capacitance	WG-216B	9 μfd , 10 megohms	2000 v. peak-to-peak; 500 v. d.c.*
Rectified R.F. or A.C. Rectifying		WG-264	1.75 μfd , 6000 ohms at 200 mc.**	20 v. r.m.s., 28 v. peak; 250 v. d.c.
Modulated R.F.	Rectifying and Demodulating	WG-291	2.25 μfd , 2500 ohms at 200 mc.**	20 v. r.m.s., 28 v. peak; 250 v. d.c.

* Approximate values which vary with instrument

** Approximate values which vary with frequency

ance divider and capacitance divider form an *RC* divider having both flat frequency response and minimum circuit-loading characteristics.

The WG-216B probe input condenser is adjustable and it is made accessible by unscrewing the contact tip. This condenser is adjusted by the manufacturer to obtain best square-wave response.

The WG-216B probe is designed for use with *RCA* WO-56, WO-57, and WO-88 series oscilloscopes. Its voltage input ratings are consistent with the input ratings of these instruments.

The two-fold purpose of a low-capacitance probe is to reduce the capacitive and resistive loading effect on the circuit being tested and to pass all frequency components in the circuit to the test instrument. The use of such a probe can in no way extend the frequency response of the test instrument. Some distorted waveforms seen on an oscilloscope, therefore, are unimproved by the addition of a low-capacitance probe. The full value of the probe can only be realized when the response of the instrument is not the limiting factor.

The low-capacitance probe used in conjunction with an oscilloscope gives that instrument a marked advantage which is readily observed when it is desired to examine the waveform in a sensitive circuit as, for example, a television horizontal oscillator. With a probe that does not have low capacitance, the waveform will change its slope and the picture will usually tear out when the oscillator is detuned by application of the probe. With the low-capacitance probe, the waveform will have a straight horizontal appearance between start and finish peaks and the TV picture is not likely to tear out during probe contact.

Isolating Probes

The *RCA* WG-217 d.c. probe is fitted with a one-megohm resistor in its housing to isolate the circuit under test from the test instrument and cable and to keep high-frequency a.c. out of the vacuum-tube voltmeter with which it is used.

When this probe is applied to the

grid of an i.f. amplifier, for example, the distributed capacitance across the one-megohm isolating resistor is the only path for high-frequency loss. Because that capacitance is negligible, no discernible detuning problem exists. Although the value of the resistor is too high to pass any appreciable high frequency, it results in perfect combination with the high internal 10-megohm input resistance of the "Volt-Ohmyst" for indication of d.c. grid bias. The total resistance of 11 megohms is great enough to allow bias reading without serious loading error.

When it is desired to read a.c. from a source which also contains d.c., a blocking condenser is necessary. This condenser may be located either in the probe or in the test instrument. Good low-frequency response requires the use of a fairly large condenser and it is normally found in the instrument simply because it would be too cumbersome to house in a probe.

Rectifying Probes

The primary function of a rectifying probe is to extend the high-frequency range of a test instrument. Used at the point of test contact, such a probe performs the function of a detector and delivers rectified output voltage proportional to the r.f. input voltage being detected. Because of the usual sine-wave composition of high-frequency voltages, rectifying probes are generally of the half-wave type capable of developing either r.m.s. voltages for vacuum tube voltmeter measurements or peak voltages for oscilloscope indication.

Depending upon whether the probe is to be used with a voltmeter or oscilloscope, its output circuit has a long or short time constant. A probe designed for use with a vacuum tube voltmeter delivers filtered d.c. output proportional to the amplitude of the r.f. wave. A probe designed for use with an oscilloscope delivers d.c. output which fluctuates according to the amplitude modulation of the r.f. wave.

Because the circuitry differs with the output requirements of rectifying probes, it is necessary to have special probes for particular applications. The

two most popular types, therefore, are described separately in the following paragraphs.

Crystal Diode Probes

The *RCA* WG-264 crystal diode probe contains a germanium crystal diode which, by proximity to the point of test, produces rectified output with a minimum of signal loss. It is a half-wave rectifier of the peak-reading type and develops a d.c. output which is indicated as a negative d.c. voltage across the input resistance of a "Volt-Ohmyst." The probe is calibrated for use with "VoltOhmysts" so that the measured d.c. output is equivalent to the r.m.s. value of the sine-wave voltage at the input of the probe.

When intermediate-frequency to v.h.f. signals are measured, r.m.s. voltage readings are normally sufficient. The measurement of video and sync signals in peak-to-peak values is not a function of the WG-264 type of probe. These values are better measured with a direct probe and a peak-to-peak reading vacuum tube voltmeter such as the *RCA* WV-97A "Senior Volt-Ohmyst."

The WG-264 crystal diode probe has an input frequency range from 50 kc to 250 mc. and an input capacitance of $1.75 \mu\text{fd}$. Its input voltage ratings are sufficient for applications in the r.f. and i.f. sections of TV sets and other low-level electronic devices.

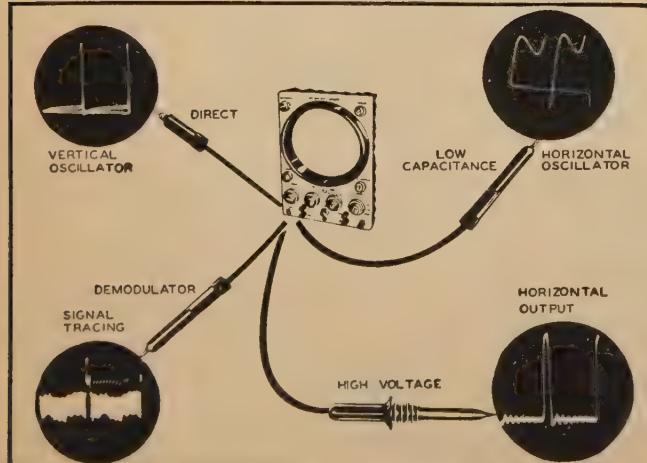
When quantitative measurement of r.f. (and i.f.) is the sole consideration, the crystal diode probe is excellent for checking stage gain, tracing signals, locating spurious oscillations, and detecting and measuring r.f. output from oscillators and signal generators.

Demodulator Probes

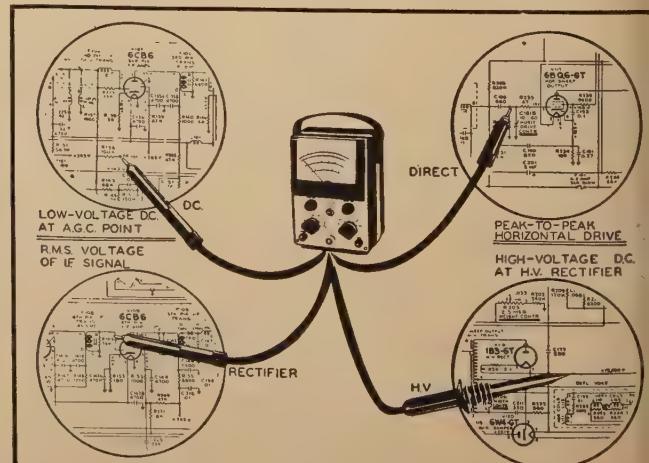
Another in the family of crystal diode rectifier probes, the demodulator probe *RCA* WG-291 serves to perform certain functions beyond the basic requirement of furnishing d.c. output. Although the demodulator probe will rectify r.f. input and produce d.c. equivalent to the peak value of the input voltage, it differs from the WG-264 in that it is not calibrated and

(Continued on page 132)

Applications of probes used in conjunction with oscilloscope.



Circuit testing with a v.t.v.m. and various types of probes.



ELECTRONIC “BUTLER AND BABYSITTER”

By SIDNEY LIPMAN

few cents a month for power and a well-stocked junk box are only requirements for building this home intercom system.

Y intercom for the home must be inexpensive to build and to operate and must be useful enough to warrant the cost. As the name implies the two most important functions of the system to be described are answering the door and keeping in touch with the “King” or “Queen” in nursery. Initial cost, if every item bought new, and the junk box can provide any help, will be about \$10 dollars and the running costs are at as much as running an electric fan—a few cents a month.

The installation described consists of three master stations and one slave station, all powered from the same transformer. Additional stations may be added or some of the stations eliminated, depending upon the requirements of the individual home, without affecting the efficiency of the system. Because of the very low power requirements, the author runs the amplifier continuously day and night and after a number of months of operation not a single component, including tubes and rectifier, has overheated. The amplifier is a high-gain, three-tube unit built on a standard 5 x 7 inch deep aluminum chassis. The tubes selected require less than three watts for heater power and the vacuum rectifier power supply requires about the same wattage. To prevent shocks from the amplifier circuit, a polarized plug was used to ensure that the chassis is always at ground potential. If a polarized plug and socket are not available, only the side of the line should be connected to one prong of the plug and the chassis connected to a water pipe

ground by a single wire. In the event the plug is not inserted properly the heaters will not light up when the switch is turned on and it will only be necessary to turn the plug over to obtain proper operation.

In the amplifier shown in the photographs a number of the resistors pictured are of greater wattage than those specified in the diagram. This is because the unit was built from junk box parts. All values shown on the diagram are for minimum wattages but no harm can be done by using a resistor of a higher wattage rating if it is more readily available. The electrolytic condensers, in some cases, are of a larger capacity and higher voltage rating than those called for in the diagram. Again the diagram values should be taken as minimum values and higher capacity or voltage ratings may be substituted if more readily available.

The biggest problem to overcome is hum pickup. The amplifier pictured uses the point-to-point wiring technique to minimize hum, with a single row of tie points to support the ground and voltage supply ends of the resistors. The decoupling and screen dropping resistors are mounted on the tie point strip. The power supply components are all arranged at one end of the chassis and the signal components at the other. On top of the chassis are placed the filament transformer and the output transformer. The heater pins of the tubes (pins 3 and 4 in all cases) face the power end of the chassis. Two leads are run to the heaters and the center tap of the transformer is grounded, to



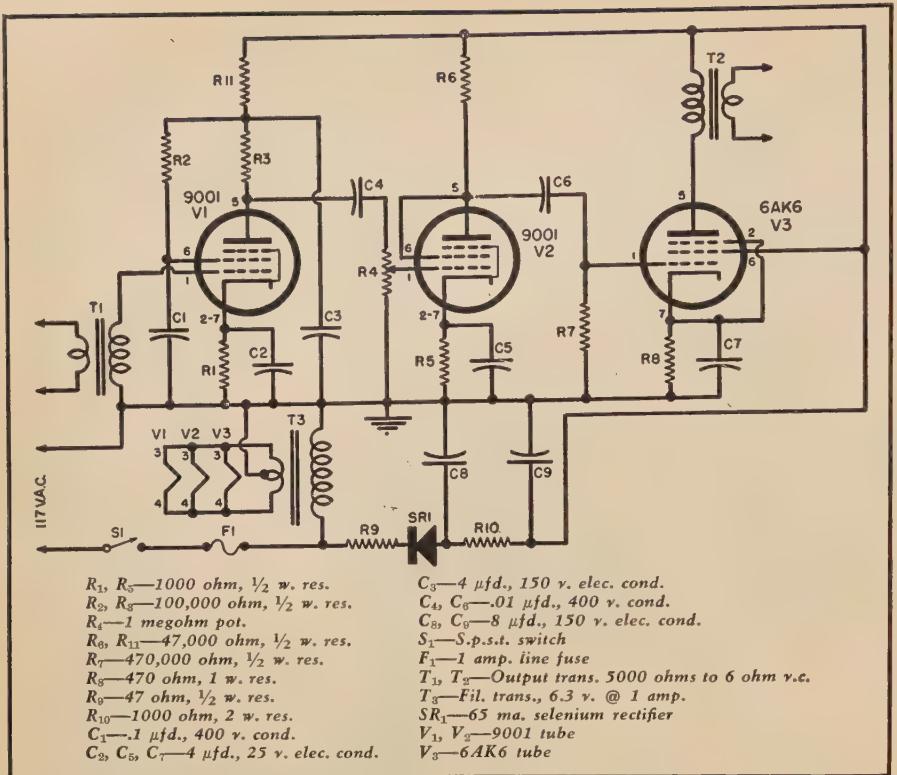
The nursery can be monitored or front door answered from the kitchen or basement with intercom.

minimize hum. The transformer mounted on the edge of the chassis is the input transformer and was mounted in this spot to—you guessed it—reduce hum. It is a standard output transformer.

The input to the amplifier uses a shielded lead with the hot wire connecting to one end of the input transformer voice coil winding at the two-terminal board and the shield connecting to the other voice coil lead. The output from the amplifier is handled in the same manner. No connection is made to the chassis and the shields are connected together only at the central terminal board mounted centrally in the cellar on a ceiling beam. The amplifier is located on a storage shelf a few inches away from the terminal board.

Each station is wired to a barrier strip connection block, and crimp-on lugs are used on all leads. This eliminates the necessity for chasing all over the house with a soldering iron and simplifies troubleshooting or the addition of more stations. Provision was made for a fifth station which will probably remain unused until a garage is built.

The station in the nursery is located between the crib and the bathinette and the pickup is sensitive enough to allow the smallest whimper to be heard. If someone rings the doorbell while baby is being bathed, the controls are within easy reach of Mother to tell the visitor to “return later” or “wait a moment” or “we do not want any.” After interviewing half a dozen storm window salesmen, Mother found it gratifying to be



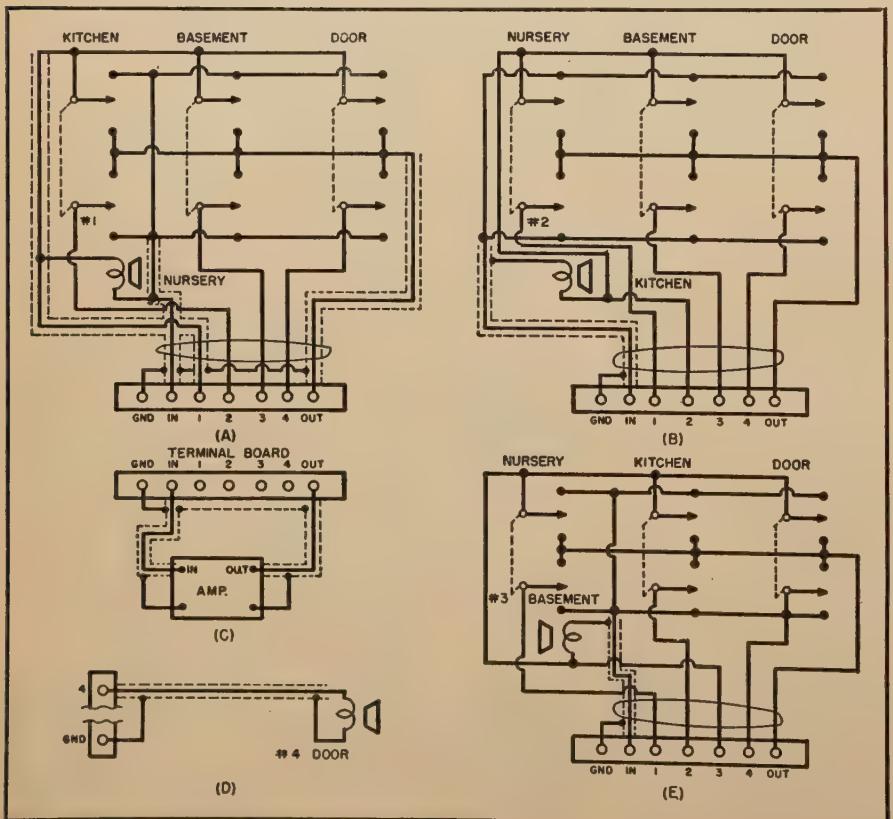
Complete schematic of intercom station. Any number of units can be used in system.

able to send the others away without subjecting baby to a draught in the middle of her bath.

The master stations are equipped with a separate double-pole, double-throw, center-off switch for each other station. The switches of all stations are normally left in the cen-

ter-off position. When a call is to be initiated, the switch for the station being called is put in the "up" position and the message delivered from any distance away from the speaker, up to four feet or more. The switch is then pushed to the "down" position to hear the answer. When the con-

Different methods for hooking up intercom system. See text for complete details.



versation is over the switch is turned to the middle position. person at the station being can need do nothing more than ans the question put to him from point in the room being called.

When the lady of the house is b in the kitchen, which is a good p of the day, she is but a step a from the baby's room at the far of the house via the speaker mounted over her work space. When sup ready it requires only a softly spoken word with the basement switch in "up" position to bring Father up f his various hobbies. A special c need not be spoiled by having to left alone at a critical moment order to answer the front door w a few well chosen words into "Butler" will keep the Fuller Br salesman on the front porch until crisis is past.

The kitchen station is mounted under the metal cabinets with self-tapping screws. There is a double bottom to the cabinets so the screws not extend through. The leads run conspicuously along the bottom of cabinets, down the edge of the tile hind the refrigerator. The station the nursery is mounted against wall with wood screws that go through screw eyes screwed along the and bottom of the cabinet. The ca runs down the wall and along baseboard until it snakes its way down a hole in the corner of the room under the crib. Standard insula staples are used for holding cable.

The front door speaker was treated with Walltex before being installed in the cabinet. This is a material that waterproofs the cone and is designed for treating wall paper to make washable. It has a wax base. The speaker cabinets were home-made of $\frac{3}{16}$ " plywood and painted to match the walls upon which they are mounted. The front door and kitchen units are painted white and the nursery unit is a cream color. After paint is dry a thick coat of paraffin wax, such as Johnson's floor wax, is applied. This makes the cabinets easy to clean as well as making them waterproof.

All speakers are protected by a piece of copper window screen with a piece of an old sheet in front of them. The holes for the speakers were cut in the plywood with a fly cutter before the cabinets were assembled. cutting half way through from one side, a neat hole is produced. The cabinets are butt joined and glued with Stanley glue. In addition a small nails, similar to those found in cigar boxes, were used to hold pieces together until the glue dries.

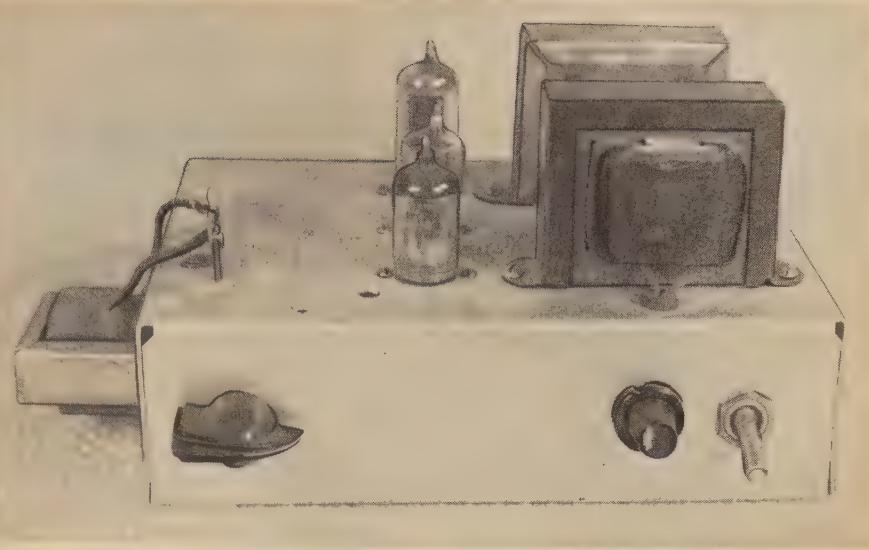
The cables running from the various stations to the central terminal board are run along the rafters. A single hole through the wood shingles where they meet the concrete foundation was used to bring the single shielded lead into the cellar from the fi

station. The wires were strung at a time and were held in place by nailing them to the floor. Nails crossed with about quarter-inch spacing between the nails. Wires can be installed by setting them at right angles to their final position, putting them behind the heads of the nails and then pulling up the slack, which puts the wires under both nails. This system allows more wires to be added any

time. The shields of the cable going to the nursery are grounded to a water pipe at a convenient spot. There should be one ground in the cable of all stations. If a ground wire is used, it should be separate and go to the nearest cold water pipe. The basement station, which is not illustrated, is slightly different. The switches controlling other stations were mounted on an inch and a half strip of aluminum which is screwed along the edge of the work bench. The speaker has a three foot wire on it so it can be set at any convenient spot on the bench, or on the floor when a big job is undertaken. There were no difficulties in hanging the speaker. The first installation was a direct line from the nursery to the basement and was responsible for the author having a chance to complete other stations while Mother was away. The slightest whimper brought her up armed with bottle, safety pin, and so on. Another labor saving convenience is the ability to tell door-to-door salesmen "we do not have any" without running up the stairs and halfway through the house to open the door.

Some trouble may be encountered if any of the cables exceed twenty feet in length. Oscillation may occur due to coupling between input and output circuits. If the wires in the cable can be spaced an inch or more apart from each other, this will not occur. However, but more expensive is shielded wire. The author found it necessary to shield only one cable, that going to the nursery. Three wires remain that must be shielded: The input, output, and the wire that is connected directly to the speaker of a distant station. The author found it convenient to run a single shielded wire to all stations for the input circuit in order to minimize hum pickup from those stations not used during a particular conversation. The shield is also used as a return, saving a wire. If possible, color coded wires should be used to simplify servicing. If this is not convenient, tag the wires so that, at a later date, you will know which is which.

As in a railroad telegraph system, the worst offense an operator can commit is to leave a switch in the wrong position. However, with this system all is not lost as is the case with the telegraph. If, for instance, Mother has left her switch for the basement station in the "down" or "open" position and Father puts his

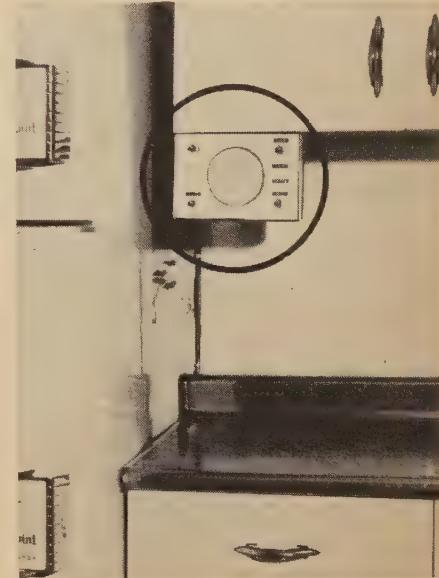


A station unit. Any cabinet appropriate to decorative scheme may be employed.

switch in the basement to the kitchen "talk" position, oscillations will be reproduced at the two stations. This will indicate to Mother that she left her switch in the wrong position and that it should be returned to its neutral position since someone is trying to call her. It also indicates to Father in the basement that his message was not received.

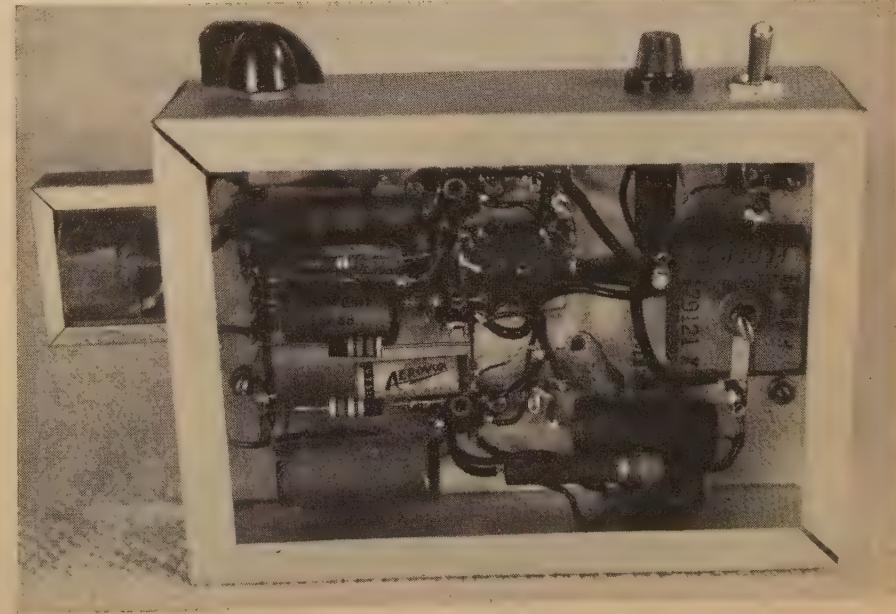
While the author claims no startling innovations for this set-up, this intercom system works well, is virtually foolproof, costs little to build, and even less to operate—all desirable features for any home intercom installation to have. In addition, it is easy to build and install.

In the few months that the electronic "Butler and Babysitter" have been working for the family, untold numbers of steps have been saved. It has also been gratifying to know that Mother need not answer the door when alone in the house without first knowing "Who's calling please?" —30—



Kitchen intercom mounted on metal cabinet.

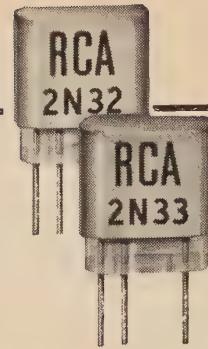
Under chassis view of station. This layout prevents overheating of components.



TRANSISTOR

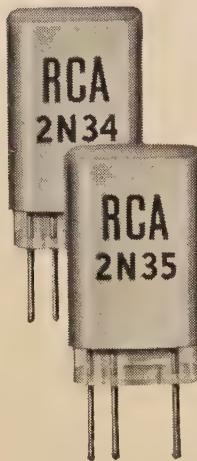
PHYSICS

Simplified



IT WAS pointed out in the previous article (July) that in a junction transistor the emitter, base, and collector connections to the crystal are low-resistance (large area) connections. In the point-contact transistor the emitter and the collector connections to the crystal are point-contact (relatively high-resistance, small area) connections. Fig. 10 is a line drawing cut-away view of the transistor. The base connection, however, is a low-resistance (large area) connection. It was mentioned in previous paragraphs that the emitter current is slightly larger than the collector current in the junction transistor and that the base current is extremely small. It has been found by experiment that in the point-contact transistor the collector current (unlike the collector current of the junction transistor) is substantially larger than the emitter current, and that the base current is relatively large. In the following paragraphs an attempt will be made to explain these differences between the junction transistor and the point-contact transistor.

Although the point-contact transistor employs what is considered to be either an *n*-type germanium crystal or a *p*-type germanium only, experimental investigation has shown that in the *n*-type point-contact transistor, *p*-type layers occur, and that in the *p*-type contact transistor, *n*-type layers occur. Fig. 11A shows an *n*-type point-contact transistor. It is seen that under the emitter point is a very thin layer of *p*-type germanium (P_1), and under the collector point is a thin layer of *n*-type germanium (N_2), followed by a thin layer of *p*-type germanium (P_2). By observation it can be seen that the emitter-base section is biased in the forward direction. Current flow consisting mainly of holes in the P_1 -type germanium and mainly of electrons in the N_2 -type germanium will occur. However, an increase in emitter current causes a large increase in collector current and a decrease in emitter current causes a large decrease in collector current. The following paragraph will attempt to explain the current amplification of the transistor. Fig. 11B is an enlarged view of the



RCA's 2N32 point-contact type designed for large-signal pulse or s ing operations. The 2N33 for oscillator applications in 50 mc. r The 2N34, a "p-n-p" junction type audio amplifier for low-power frequency applications. RCA's 2N35, an "n-p-n" junction type audi plifier for low-power, low-frequency use. (Above) Westinghouse's WX

By

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Part 2. Concluding article covers point contact type transistors, their design, construction, and circuit applications.

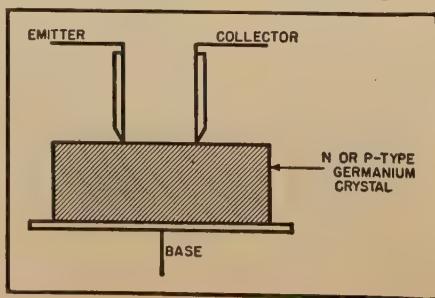
collector-base circuit. The potential energy diagram for electrons in the crystal portion of this circuit is shown in Fig. 11C. Under steady-state conditions (no signal applied), very few electrons climb the potential energy hill between N_2 and P_2 . However, those that do climb the hill do not combine with the holes in the P_2 region because it is a thin region. These electrons fall quickly down the potential hill between P_2 and N_1 . When the emitter-base region conducts, some of the holes which leave the P_1 region of the emitter, drift into the P_2 region of the collector. With holes in the P_2 region from the emitter, the potential energy diagram for electrons between the collector and base conforms to that in Fig. 11D. Note that the potential energy hill between N_2 and P_2 has been substantially reduced, and electrons in the N_2 region can climb readily into the P_2 region. Most of these electrons do not combine with holes

in this region, but fall very rapidly into the N_2 (base) region. For each hole that enters the P_2 region from the P_1 region, many electrons flow up the N_2 region through the P_2 region down into the N_1 region. Thus, it is seen that large current amplification may be effected. This amplification of current is expressed as α (alpha) and is equivalent to μ (the vacuum amplification factor of a vacuum tube). Mathematically, $\alpha = \Delta I_c / \Delta I_e$, where ΔI_c equals a small change in collector current, and ΔI_e a small change in emitter current.

Point-contact transistors have been made with *p*-type germanium as the main body. The theory explaining the operation of this type point-contact transistor is similar to that explaining the operation of the *n*-type point-contact transistor. The difference, of course, is that the main current carrier consists of holes instead of electrons. The explanation in the preceding paragraph coupled with the information in Fig. 12 will enable the reader to understand the theory of operation of *p*-type point-contact transistors. Note that the polarities for the emitter with respect to the base, and for the collector with respect to the base have, if necessary, been changed.

The operation of a point-contact transistor can be compared to the operation of a triode vacuum tube. The emitter is equivalent to the cathode, the base to the anode, and the collector to the plate. The base current is relatively large, and the major

Fig. 10. Line drawing of a cutaway view of a transistor of the point-contact type.



of it goes to the collector. Unlike grid of a vacuum tube, the emitter draws a continuous current. The (emitter) impedance is low and output (collector) impedance is high. In a vacuum tube the input impedance is high and the output (plate) impedance is low. For a comparison of transistors and vacuum tubes see Tables 1 and 2.

Bias Voltages

In a vacuum tube the grid is usually biased negatively with respect to the cathode, and the plate is made positive with respect to the cathode. In the transistor the collector may be positive or negative with respect to the base, and the emitter may be positive or negative with respect to the base. These are illustrated in Fig. 11. The bias polarities depend on whether the transistor is an *n-p-n* or *p-n-p* junction type, or a *p* or *n* point-contact type. To simplify the problem for the technician, the diagrams of Fig. 11 have been prepared, which state bias polarities required for various types of transistors. If one remembers that the *n*-type point-contact transistor is, by stretching the definition a bit, actually a *p-n-p* transistor, and the *p*-type transistor is an *n-p-n* transistor, bias polarities can be remembered easily by the following simple rule. The emitter is biased in a forward direction with respect to the base and the collector is biased in the reverse direction with respect to the base, in any transistor.

Conclusion

These articles have presented in a descriptive, non-mathematical way the fairly complicated physics of transistors. Although this type of treatment is inadequate for those interested in a quantitative presentation, I hope that the average radio-television technician will have a greater understanding and appreciation of circuits employing transistors instead of vacuum tubes. It may be mentioned here briefly that major differences occur in transistor circuits compared with the corresponding vacuum tube circuits. This is a study in itself and since this article was designed to be merely an introduction to the large number of transistor circuits which will make their appearance on the radio-television horizon, no attempt has been made to discuss specific circuitry.

Many articles have been written on the theory of transistor physics; however, these articles explained only the mathematical concepts, as a result, to coin a phrase, "did it home" as far as the technician or engineer who is not directly concerned with transistor application. In this article the authors have attempted to provide the theoretical justification for a different method of practical transistor physics presentation.

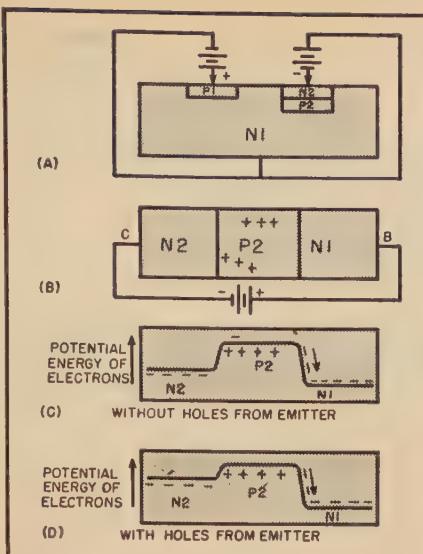


Fig. 11. An "n" type point-contact type of transistor. See text for complete details.

VACUUM TUBE	TRANSISTOR
Cathode	Emitter
Plate	Collector
Grid	Base
$\mu = \Delta E_p / \Delta E_g$	$a = \Delta I_c / \Delta I_e$
Voltage Amp.	Current Amp.
High Input Imp. (grounded cathode)	High Input Imp. (grounded emitter)
Low Output Imp.	Low Output Imp.
High Power Consumption	Low Power Consumption
Fragile	Rugged
Large in Size	Small in Size

Table 1. Comparison of characteristics between vacuum tube and a junction transistor.

Although the transistor is only five years old, much is expected of it in the near future. Many electronic units will be freed from the vacuum tube's limitations, namely, fragility, bulkiness, and short life. To think that in such a short time since its inception, the combined production of transistor makers has resulted in an output of 50,000 units a month. Before the end of 1953, output is expected to exceed 250,000 units a month. Is it any wonder that they call transistors the miracle of the Twentieth Century?

From the outset of radio it has been known that semiconductors, such as galena, have the ability to rectify alternating current signals. In fact, the "cat whisker" galena crystal was a standard part of the early radio set. But the fundamental reason why some substances conduct and others do not had to be investigated by some of our leading physicists before the transistor became a reality.

Transistors have been introduced successfully in such units as the phono amplifier, radio and television receiver, hearing aid, "walkie-talkie" set, radar spotting device, computer, and other devices which employ, at present, vacuum tubes. No theoretical limitations are placed on transistor applications. The experts are optimistic about the possibility of overcoming present transistor limitations, i.e., the higher noise level and the effects of heat and humidity upon its operation. Because the transistor is still in its infancy, it is undoubtedly just a mat-

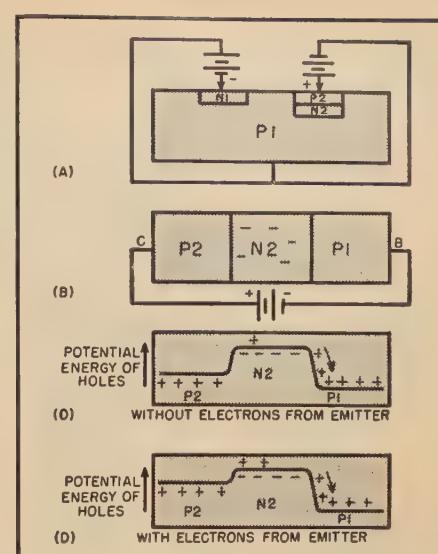


Fig. 12. A "p" type point-contact transistor. Note differences from Fig. 11, left.

VACUUM TUBE	TRANSISTOR
Cathode	Base
Grid	Emitter
Plate	Collector
Voltage Amp.	Current Amp.
$\mu = \Delta E_p / \Delta E_g$	$a = \Delta I_c / \Delta I_e$
High Input Imp.	Low Input Imp.
Low Output Imp.	High Output Imp.
E_p	E_c
E_g	I_c
E_v	E_e
Constant E Supply	Constant I Supply
Capacitance	Inductance
Large in Size	Small in Size
High Power Consumption	Low Power Consumption
Fragile	Rugged
Reverse Bias	Forward Bias

Table 2. Comparison between point-contact type transistor and standard vacuum tube.

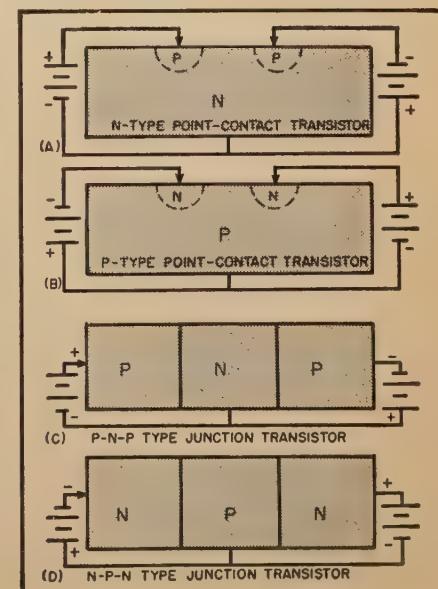
ter of time until these problems are ironed out.

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—: "Transistor", Proceedings of the IRE, November 1952.

Fig. 13. Emitter and collector bias voltages for different types of transistors.



TV TROUBLESHOOTING

HIGH-VOLTAGE SUPPLIES

By
MILTON H. LOWE

*Flyback type high-voltage circuits: how they operate,
and hints for time-saving receiver troubleshooting.*

A FEW years ago, before 19 and 21 inch picture tubes made their appearance, 9 or 10 kilovolts were all that were required to operate the average "kine." Nowadays, 15 kilovolts is quite common, and the high voltage required increases as picture tubes get larger. You have probably noticed that the physical size of components, such as the flyback transformer and high-voltage rectifier tube, have not kept pace with the demands placed upon them. If anything, the tendency is towards smaller and smaller parts whose values must be calculated critically in order to obtain the desired results. Replacing these parts without regard to tolerances and characteristics may cause troubles that did not exist before the repair was made. The best way to avoid these additional bugs is by being careful while troubleshooting, and by using correct replacement parts.

In an effort to improve the performance of the high voltage power supply, some 1953 television receivers utilize a flyback transformer of new design. It has a number of extra primary taps to which the damping diode is connected, in contrast to the older types where the damper is connected across the secondary. The principal advantage of this design is the reduction of transformer leakage inductance and distributed capacity, thus extending the high frequency response of the transformer. This results in a lower horizontal retrace time and, ultimately, reduces the problem of horizontal foldover due to lack of transformer response.

Typical varieties of the newest types of high-voltage supplies are shown in

Figs. 1 and 2. Fig. 1 is the partial schematic diagram of the parts that comprise the high-voltage supply of *Admiral* chassis 19H1. The operation of this type flyback circuit is similar to the older types. The output of the horizontal oscillator is applied to the 6BQ6 horizontal output tube where it is amplified. The "Horizontal Drive" condenser and the 680 μfd . coupling condenser comprise a voltage divider for the grid input signal. For proper operation of the circuit, the "Horizontal Drive" control is adjusted so that the saw-tooth shaped grid signal has a peak-to-peak amplitude of 65 volts. The 68-ohm grid loading resistor minimizes the tendency toward Barkhausen-type parasitic oscillations. A negative grid potential of approximately 24 volts is developed across the grid-leak network consisting of the 1-megohm grid return and the "Horizontal Drive" condenser (in series with the 68-ohm resistor). This potential, in conjunction with 5 volts of self bias developed across the 47-ohm cathode resistor, results in a total of approximately 30 volts of grid bias. This is a convenient number to remember when troubleshooting most horizontal output grid circuits, because one measurement from grid-to-cathode will indicate if the drive and bias are approximately correct. The amplified plate signal is applied to the horizontal deflection coils; stepped-down to produce the 1.5-volt filament potential for the 1B3; and stepped-up to produce the high voltage pulse, which is rectified and filtered to produce the high voltage output.

During the horizontal retrace, or

flyback time, the horizontal output tube stops conducting, and a large pulse of voltage is developed across the flyback transformer due to rapidly collapsing flux lines. This pulse would induce transient oscillations in the yoke were it not for a damping diode, which is driven into conduction at this time, reducing the magnitude of the voltage across the coils and causing the oscillations to decay quickly. The "pi" network, consisting of the linearity coil and two .047 μfd . condensers, filter the rectified pulse to produce the "B" boost voltage (approximately 1500 volts). A good point to remember about "pi" networks is that the input leg has the greatest effect on the amplitude of the network's output voltage, whereas the output leg has the greatest effect on the phase shift through the network. Thus, the .047 μfd . input condenser should be suspected if the boost voltage is too low, and the output .047 μfd . condenser should be suspected if the linearity of the picture is unsatisfactory.

The linearity and width coils are both tunable to provide for shaping the horizontal deflection current by shifting its phase with respect to applied voltage. These controls interact and must be adjusted alternately to obtain the desired picture width and shape. The width coil is split into two parts so that a given minimum of inductance shorts the lower portion of the flyback transformer irrespective of the setting of the width control.

Defects in the grid and screen circuits of the output tube produce symptoms similar to those obtained in a grid-leak biased audio amplifier. For example, if the 1-megohm grid return should increase in value, there is a strong possibility that the high voltage would be intermittent in a fashion that would be the visual counterpart of the aural motorboating effect. If the .047 μfd . screen bypass should become slightly leaky, the width would be reduced somewhat. If the condenser should become very leaky, the brightness and/or width would noticeably affect.

Fig. 2 is a simplified schematic of a flyback circuit that is a modified version of the type shown in Fig. 1. This circuit is used in the *Crosley* chassis 387, *Motorola* chassis TS-410A, and many other receivers, and is a beautiful example of simplified design. The principal difference, compared to the circuit of Fig. 1, is the noncontinuous flyback primary. A 50-ohm potentiometer, used for horizontal centering, separates the upper and lower portions of the flyback primary. Note that a portion of the upper half of the primary is tunable by means of an adjustable slug. This provides a means for adjusting picture width by changing the high voltage by a small amount (the picture width is a function of two variables, namely sweep and high voltage, with the high voltage having the greater effect).

MANUFACTURER	OUTPUT TUBE GRID	GRID TO CATHODE BIAS
SONY	W 120V.	-20V.
ROLA	M 70V.	-29V.
ANIA	W 105V.	-30V.
DNT	W 60V.	-28V.
RAL	W 90V.	-36V.
COLUMBIA	W 100V.	-35V.
SPIC	M 75V.	-35V.

Fig. 1. Signal waveshape and the bias of the grid of the horizontal output tubes of some commercial TV receivers.

apparent brightness is not affected, because the change in high voltage is very small, about 30 volts. With a change of this order, the CRT is visibly affected. Notice, also, that the grid-leak bias is 27 volts, a value close to that of the circuit in Fig. 1. The boost potential, approximately +490 volts, is applied through horizontal centering control and output transformer to the plate circuit of the horizontal output tube. A parallel LC network is used to decouple the horizontal deflection coils from the damping circuit. The 2.2-kilovolt current limiting resistor is used instead of a 4.7-ohm resistor to change the load that the deflection winding presents to the circuit.

An older type flyback circuit using a high efficiency ferrite core in the former is shown in the simplified schematic of Fig. 3. The 500 μ fd. condenser connected from the 1B3 pent winding to the high side of the secondary is the principal factor that permits a 14-kilovolt output to be obtained from this type of circuit. It applies a 3-kilovolt negative pulse, which is developed at the high side of the secondary at the same instant that the positive high-voltage pulse is developed across the primary, to the pent winding thus boosts the over-all potential across the high-voltage rectifier. The 550-volt boost voltage developed across the .22 μ fd. damper-ode filter is applied to the horizontal output plate circuit and to the first anode. The deflection coil connected across the output transformer secondary to obtain an optimum impedance match between the plate and the yoke, so as to minimize the tendency towards high-frequency ringing, which would appear as alternating light and dark vertical lines or on the raster. The potentials developed in this circuit are much the same as those in the previous two. A word of caution is necessary before

discussing the troubleshooting procedures. The most dangerous stages to troubleshoot are the horizontal output, damper, and high-voltage rectifier. Especially dangerous is the plate circuit of the horizontal output tube. This is due to the fact that the plate cap of this stage has a "B+" potential of from 400 to 600 volts in addition to an r.f. pulse of some 3 to 5 kilovolts. Thus, you have the combined dangers of the very lethal "B+" supply, and the possibilities of a "burn" from the r.f. Many technicians can attest to the fact that the plate cap of the output tube is far more "shocking" than the plate cap of the rectifier. Also, most test equipment is not designed to handle the high potentials found in these circuits. Therefore, specially insulated test leads, high voltage probes, and voltage dividers should be resorted to in order to obtain a proportional indication of the voltages and waveshapes present.

Troubleshooting

Assume that the trouble symptom is a black CRT (sound normal). Only two possible troubles exist: either the CRT is dead or the high voltage is missing. A quick, though inconclusive, check of the CRT is to see if the heater is lit. If so, the trouble is probably in the high-voltage circuit, unless the customer has described symptoms that may lead you to believe that the CRT has gone. To check the high-voltage circuits, turn off the power and disconnect the lead to the CRT high-voltage button. Place the lead within $\frac{1}{4}$ " of the chassis and turn the power on again. An arc should be drawn if the high-voltage circuits are operating. If the arc is drawn, either the CRT is defective, or the CRT biasing circuits, including the brightness control, should be checked for a condition that would prevent the CRT beam current from flowing. Do not allow the arc to be drawn for more than a few moments as the current-limiting resistor in the rectifier filament circuit may be damaged.

If the arc is not drawn, use a well insulated screwdriver to pull an arc from the plate cap of the rectifier. It should be about $\frac{3}{8}$ " long for a 15-

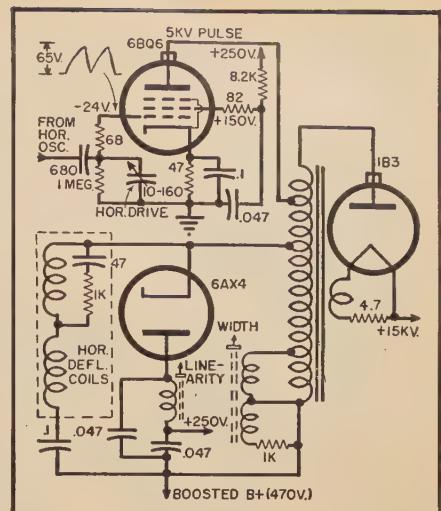


Fig. 1. Partial schematic of the high voltage circuits of Admiral 19H1 TV chassis.

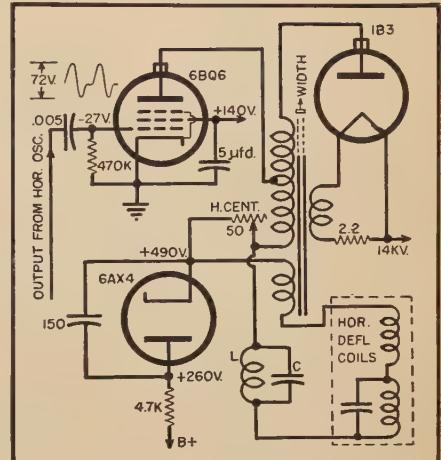
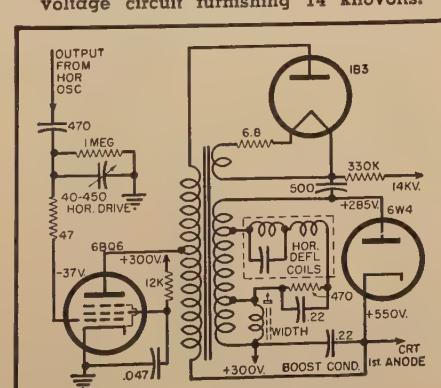


Fig. 2. Flyback transformer circuit of the Motorola TS-410A and Crosley 387.

kilovolt potential. If an arc is obtained at this point, but not at the end of the high-voltage lead, the high-voltage rectifier tube is probably defective. Also, check the high-voltage filter condenser, if a physical one is used. If the arc is appreciably less than $\frac{1}{4}$ ", the high voltage is too low and the CRT may not be bright for this reason. This point is discussed more in detail a little later. If an arc is obtained, touch the screwdriver to the plate cap of the horizontal output tube. Listen for a "click" in the speaker, and look for a very small spark at the point of contact. If both are obtained, the chances are that the output stage is OK. In this case, check the flyback transformer. (When the power is on, do not short the plate of the output tube to the chassis as this will cause either the low voltage fuse or low voltage rectifier tube to blow.)

A crude indication of the relative condition of the flyback can be obtained with an ohmmeter. The resistance from the plate cap of the output tube to the plate cap of the rectifier will range from 200 to 600 ohms, depending upon the type of flyback used.

(Continued on page 118)



BUILDING THE

E-V Regency

By
HOWARD SOUTHER
 Electro-Voice, Inc.



"Phantom" view of the
 Electro-Voice "Regency" enclosure.

Design details on a commercial folded horn enclosure which can be used with any high-quality 15" loudspeaker system.

THE SEARCH for better bass response in loudspeaker systems proceeds apace. In the design of an enclosure for promoting superior reproduction in the lower octaves, certain practical considerations often enter into the choice of construction.

For instance, a room corner is not always available. This design includes an operational as well as functional styling which allows wall or corner placement. The height of the unit is sometimes important, because a window sill, picture, or series of shelves may intrude. Accordingly, the unit described is designed to standard lowboy height of approximately 29 inches, just missing the usual window

sill and matching the height of other contemporary furnishings.

For the widest choice of driver complement, the acoustic loading permits a higher, more economical crossover point by allowing front radiation from the large driver cone. Thus, a high-frequency horn of small dimensions (the E-V Model 8-HD) can be housed within the structure with ease.

A horn is conceded to be the very best coupling medium for a high quality system. When this horn uses the corner of the room to extend the mouth opening, we have what is called a *folded corner horn*. These horns call for a very low crossover and the use of multiple components when they are of the indirect radiator type, such as the Klipsch "K" design. A more compact and economical system with 800 cps crossover must include front radiation from the driver cone for the frequencies above 300 cps. This is because the higher frequencies experience difficulty in following the circuitous path of the folds.

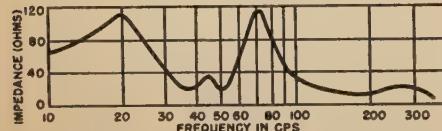


Fig. 1. Impedance curve of the "Regency" with E-V 15-inch driver of 37 cps free-space resonance. See text for details.

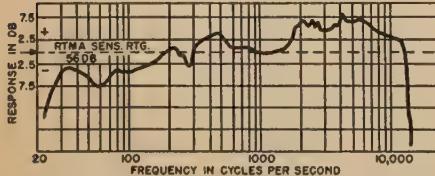


Fig. 2. "Regency" frequency response with 114-A 800 cps separate two-way system.

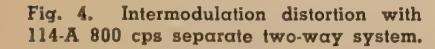


Fig. 4. Intermodulation distortion with 114-A 800 cps separate two-way system.

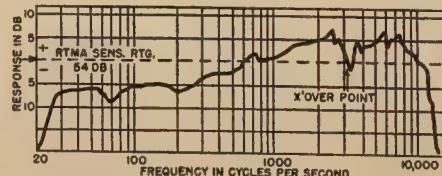


Fig. 3. Frequency response of the "Regency" with the SP15 "Radax" coaxial driver.

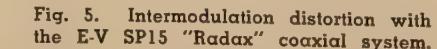


Fig. 5. Intermodulation distortion with the E-V SP15 "Radax" coaxial system.

The "Regency" is an acoustic system of the latter type, permitting direct radiation of the frequencies above 225 cps and efficiently horn load the back of the cone for the tones below this point.

Because the "Regency" has its integrally "built-in" corner with a taper-rate, it may also be employed against a flat wall. In this case, extended bass range is preserved, at a slightly lower efficiency than when used in a corner. The two sides of the cabinet, along with the floor and adjacent wall, form a compact horn, only the cabinet side of which is slightly compromised. Thus, very satisfactory extended bass is achieved at good levels. The listening results are supported by the impedance characteristic (Fig. 1), showing a very high reactive component in the 100-300 cps region.

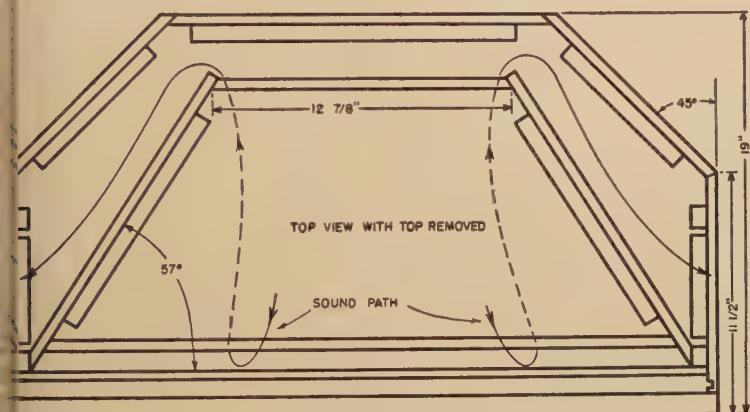
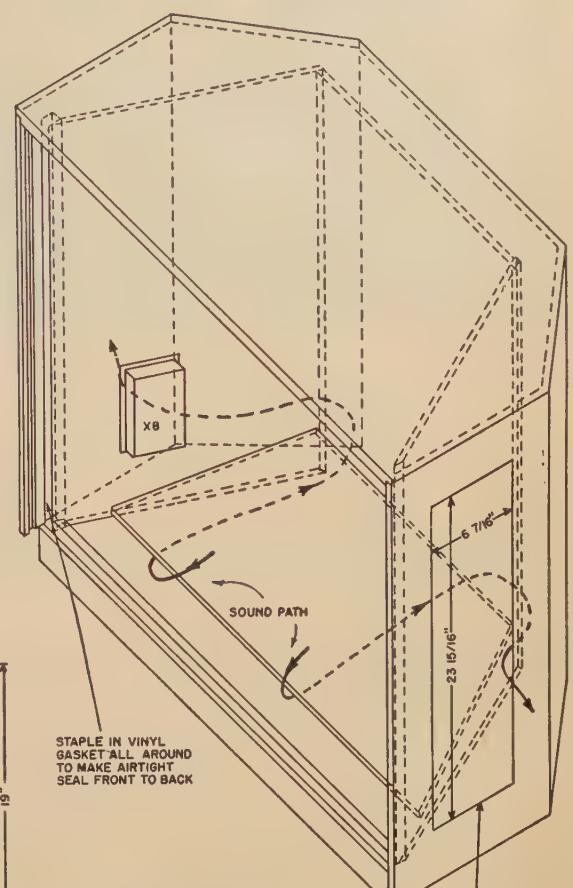
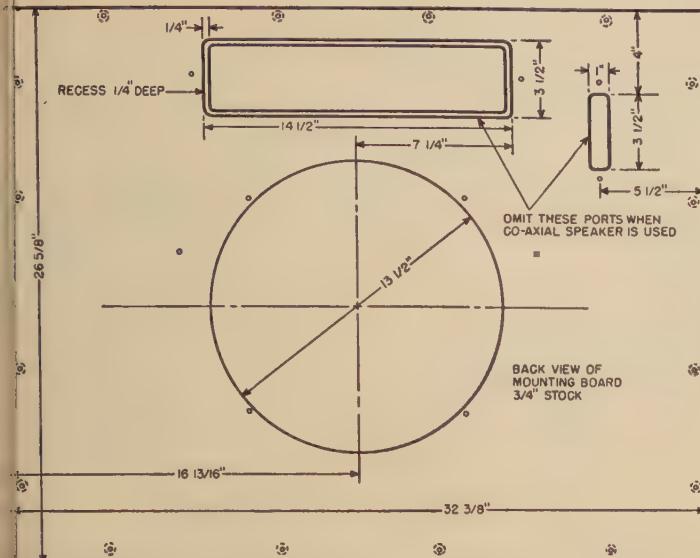
Performance

Performance with the *Electro-Voice* 114-A and 114-B two- and three-way systems using the 15W-1 15" driver, indicates unusual efficiency in the 30 cps region (Fig. 2). Harmonic distortion at the usual low room-power levels is on the order of 2%.

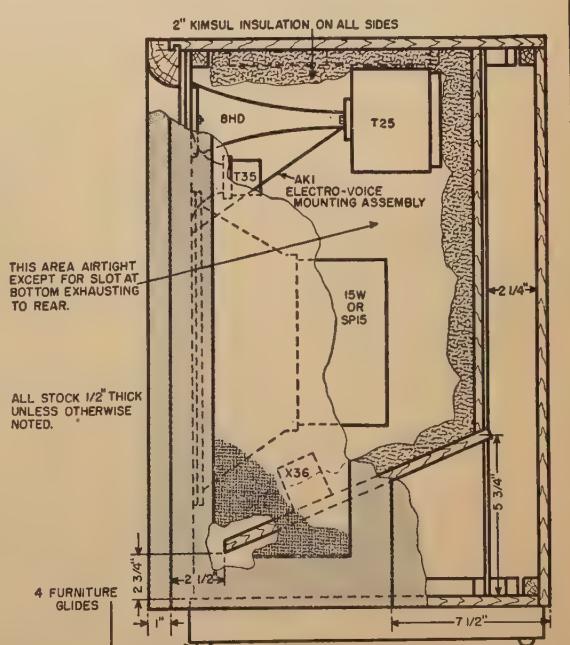
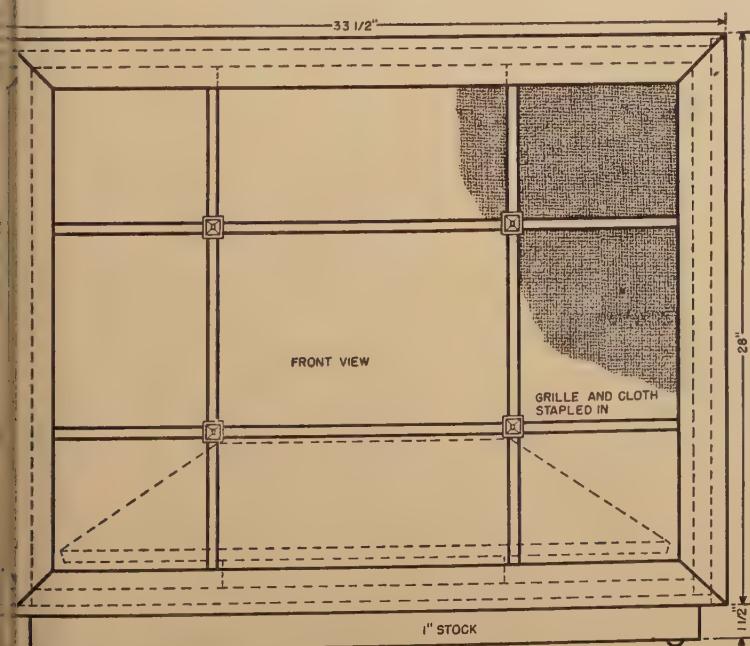
A 15" coaxial driver (the E-V SP15) shows no less than 3% distortion at low levels. Remarkably enough, at higher levels around 10-15 watts per watt, this driver shows less distortion than the multiple-way 114 series systems. This is true because the coaxial systems are more sensitive, or efficient, and are being driven harder by the same power input. At the same listening levels they have appreciably less distortion than the coaxial units.

Where extended high-frequency response is desired as a pleasing balance to the bass efficiency, the E-V "Super-Sonax" very-high frequency driver may be added as shown on the facing page. This is the equivalent of the 114-B three-way system, and requires the supplementary X-36, 150 cps network and AT-37 high-frequency level control.

Mechanical details for constructing the Electro-Voice "Regency" loudspeaker enclosure. This housing is designed to accommodate a single 15" speaker, a 15" coaxial unit, or two- or three-way systems. For a two-way system it is necessary to add a high-frequency diffraction horn and with a three-way system a very high frequency tweeter is used.



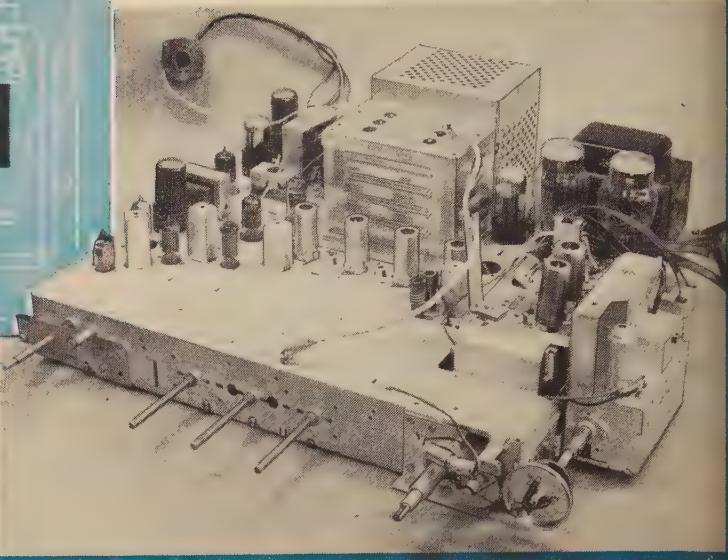
VIEW WITH FRONT MOUNTING BOARD REMOVED



KNOW YOUR 1953 EMERSON TV RECEIVERS

By
BRON KUTNY
Educational Director
Emerson Radio & Phonograph Corp.

Front view of the Emerson chassis 120174B showing the u.h.f. tuner at the lower right.



WITH more television stations going on the air daily, and with more communities being served by u.h.f. or v.h.f. stations, or both, Emerson's new line of TV receivers contains models suitable for all types of reception.

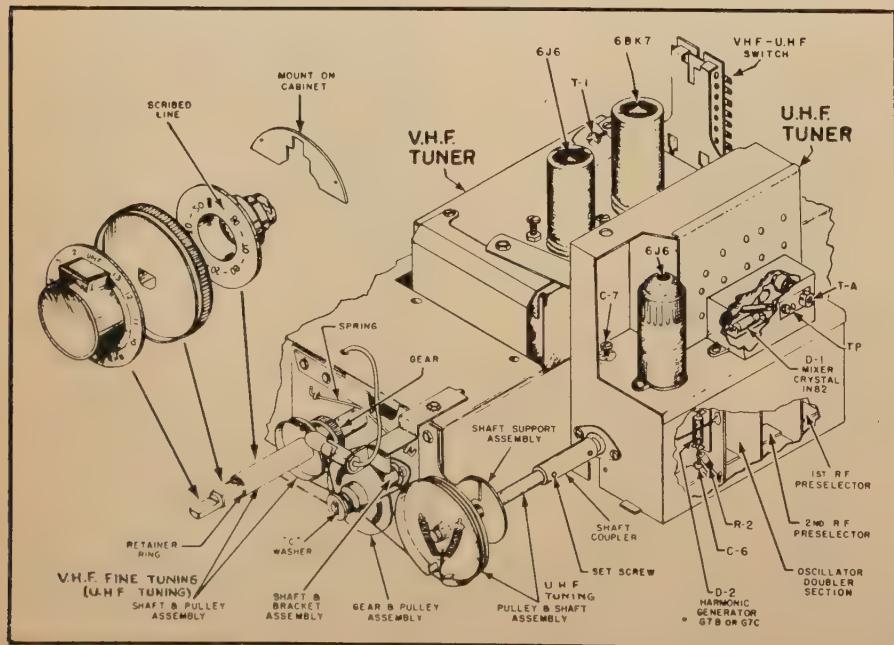
Ultra-High Frequency Tuner

In the all-channel chassis 120174B, a continuous tuner is used in order to receive Channels 14 to 83. For the v.h.f. Channels 2 to 13, a cascode amplifier turret tuner is used. Tuning is accomplished by means of a two-part concentric control for both v.h.f. and u.h.f. so as to reduce the number of knobs necessary for the customer to handle, and also to simplify the appearance of the receiver. With this

arrangement, the customer uses the channel selector and fine tuning controls for v.h.f., and only a single control, the v.h.f. fine tuner, for u.h.f. The fine tuning control is connected through a gear and dial cord arrangement to the u.h.f. tuner control shaft (Fig. 1).

Conventional balanced - to - ground 300-ohm input is provided for the u.h.f. tuner by two loops of wire fed through the tuner housing and fastened to the tuner chassis. (See Fig. 2.)

Fig. 1. Combination of u.h.f. and v.h.f. tuners showing the tuning mechanism.



The v.h.f. tuner uses the standard put coil arrangement.

The u.h.f. tuner consists of two preselector tuned circuits which are equivalent to shorted-end resonators. These lines are shorter than a quarter wavelength for all u.h.f. channels and, therefore, appear as impedances whose electrical length can be varied by the variable condenser in the open end. The plates of this variable condenser are sometimes bent and may seem to be out of shape. *Solely no attempt should be made to straighten these plates.* They are bent to maintain proper tracking over the entire tuning range. The r.f. resonant lines are coupled through the respective shields, either by loops through openings, or by slots in the shields.

A 6J6, operating as a push-pull oscillator using lumped constants, oscillates at one-half the desired frequency. This push-pull arrangement contributes to stable operation. To obtain the second harmonic frequency which is needed in the mixing action, the tank of the oscillator is coupled to a harmonic generator G7B or crystal. The second harmonic frequency output from the crystal is coupled to a harmonic selector transmission line. The signals from this harmonic selector line, and the second r.f. selector, are fed through coils L₆ and L₇ to a 1N82 mixer crystal (D₁, in Fig. 2). The 40-mc. output is then applied to the 13-position v.h.f. turret tuner where the 6BK7 r.f. amplifier is used as a low-noise 40-mc. i.f. amplifier.

(See Fig. 3.) The 6J6, V_2 , which receives no oscillator plate voltage in the u.h.f. position and, therefore, oscillator section is completely inactive during u.h.f. reception. The latter portion of the 6J6 has a negative voltage applied to its grid from a negative tap on the power supply through the u.h.f.-v.h.f. switch and i.f. tuner test point, and it becomes another low-noise triode i.f. amplifier. The output from the i.f. preamplifier is then fed to the standard 40-mc. i.f. amplifier on the main chassis. In the v.h.f. position, when u.h.f. oscillator operation is not required, the plate voltage is reduced but not eliminated. This is done to prevent cathode poisoning.

All u.h.f. tuners are pre-aligned at the factory and will not normally require adjustment in the field. However, if the 6J6 u.h.f. local oscillator is replaced, the tracking on the u.h.f. band may be off slightly. Under these conditions, it would be best to try several 6J6's until one with similar characteristics to the original is found. If another tube is not available, it may be necessary to compensate for the minor difference by adjusting C_7 (see Fig. 1) slightly for the highest channel received.

A combined u.h.f.-v.h.f. antenna can be connected to the receiver through common 300-ohm lead-in, or separate u.h.f. and v.h.f. antennas can be connected through independent lead-ins. An internal connector is provided for the common lead-in, and connects the antenna into the u.h.f. or v.h.f. tuner when the channel selector is rotated to the desired position. If separate antennas are used, this connector can be removed from the outside of the cabinet and requires no external adjustments.

The u.h.f.-v.h.f. switch, shown in the upper left of Fig. 4, is automatically operated by a cam located on the u.h.f. tuner shaft. This cam changes the switch from its v.h.f. position (as in Fig. 4) to its u.h.f. position (slides the step down) whenever the v.h.f. tuner is set for u.h.f. operation. In the v.h.f. position, the antenna is connected through switch contacts 8-9 and 17-18 to the high-pass filter L_5 , and thence through switch contacts 3 and 11-12 to the v.h.f. tuner. "B+" is supplied to the u.h.f. tuner through the 100,000-ohm resistor R_6 , preventing the 6J6 in the tuner from oscillating but allowing some current flow through the tube to prevent its cathode from being poisoned during long periods of v.h.f. reception when it is operative.

With the switch in the u.h.f. position, the v.h.f. antenna, or combination u.h.f.-v.h.f. antenna, is disconnected from the v.h.f. tuner and connected through switch contacts 7-8 and 16-17 to the input of the u.h.f. tuner (terminals 3 and 4 on the connector TS-1 in Fig. 4). If a separate lead-in is used for u.h.f., it should be connected directly to the u.h.f. tuner

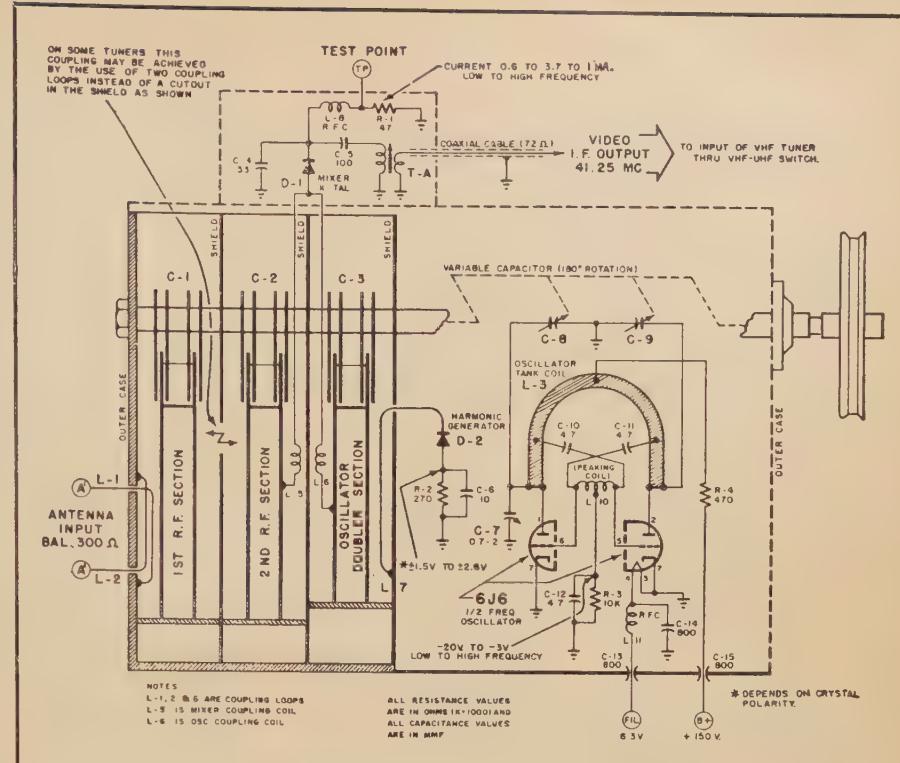


Fig. 2. Schematic diagram of the Emerson u.h.f. tuner showing test points.

antenna terminal; terminals 3 and 4 on the connector strip should be disconnected. The single-ended output of the u.h.f. tuner is fed through switch contacts 1 and 2 to the input of the v.h.f. tuner. The 100,000-ohm resistor, R_6 , is shorted out by the switch through contacts 14 and 15, so that full "B+" (150 volts) is applied to the u.h.f. tuner. To enable the v.h.f. mixer tube to function as a 40-mc. amplifier when tuned to u.h.f., fixed grid bias is applied to the mixer through switch contacts 5 and 6 and the v.h.f. test point. Of course, the high-pass filter is switched completely out of the circuit for u.h.f. operation.

The i.f. amplifier is of conventional design, using three 6CB6's in three stagger-tuned stages. (See Table 2 for

alignment of the i.f. amplifiers.) The first and second i.f. amplifiers are controlled by an a.g.c. line that is independent of the r.f. a.g.c. For this intercarrier receiver, the sound is taken from a 4.5-mc. take-off in the second detector output circuit and fed to the sound i.f. amplifier. The signal is limited by a 6AU6, detected by a Foster-Seeley discriminator, and then fed to a conventional audio output circuit. Table 2 contains alignment instructions for the sound section of the receiver.

Delay in Tuner A. G. C.

A subject worth going into is the a.g.c. because of its deviation from the common types of a.g.c. found in most receivers. To appreciate the

Fig. 3. Schematic diagram of the Emerson v.h.f. tuner described in the text.

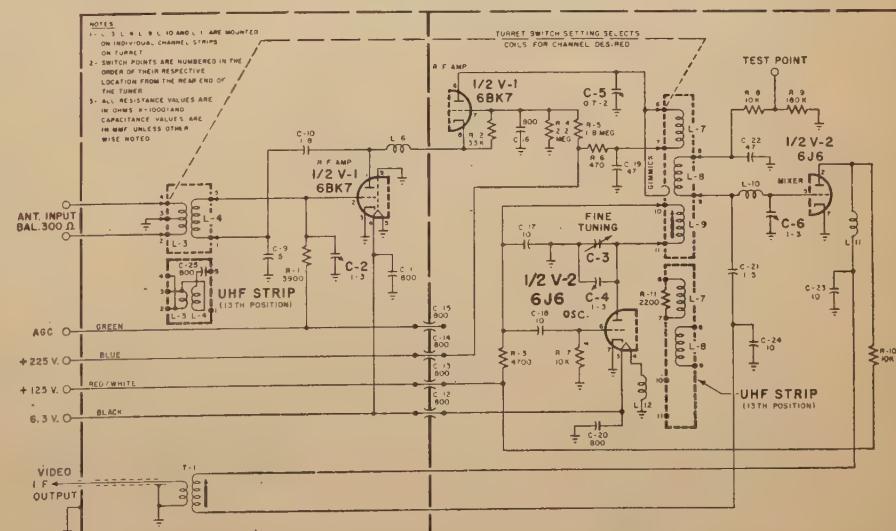
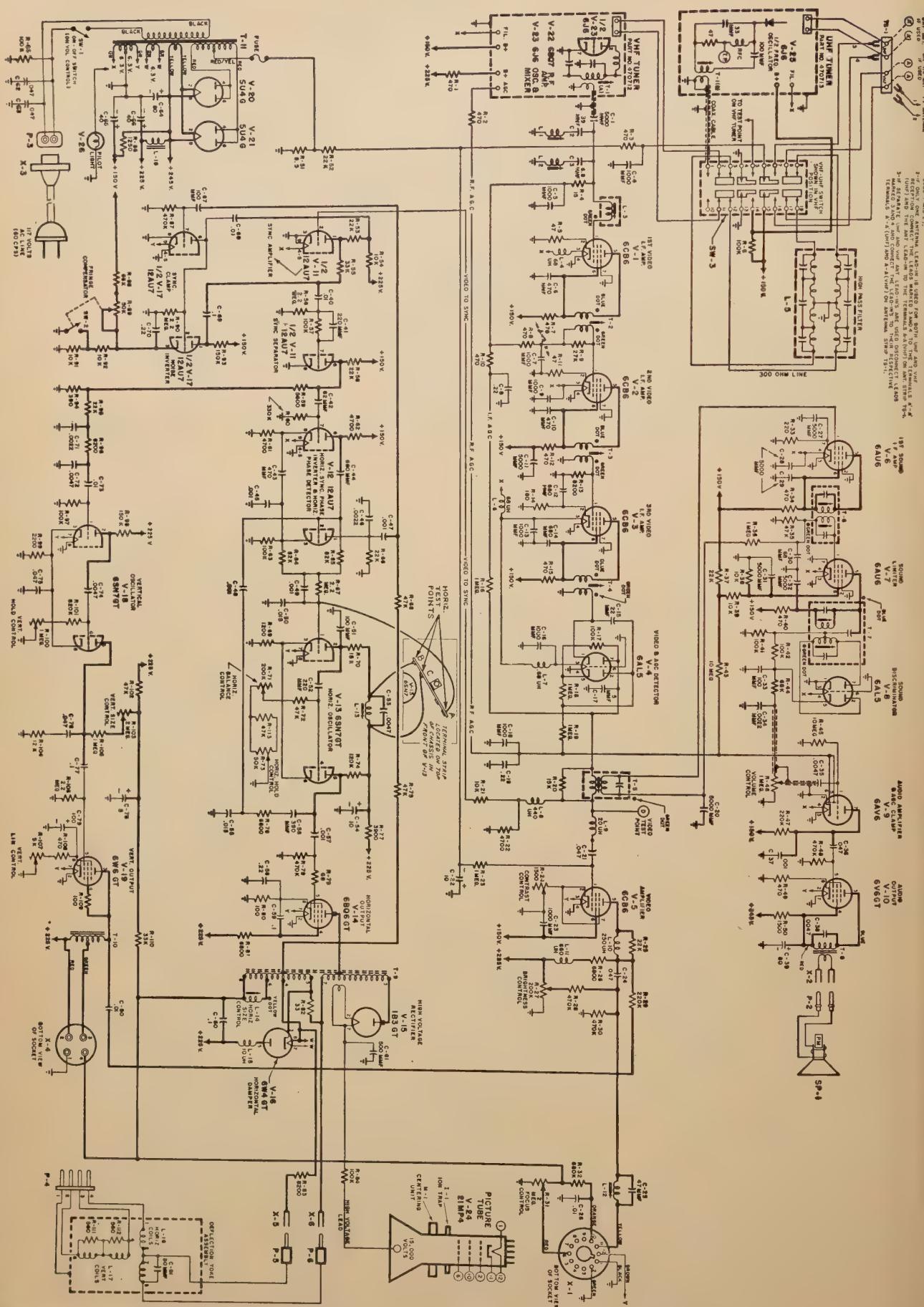


Fig. 4. Complete schematic diagram of the Emerson 120174B chassis.



ion, the need for it must be understood. television receiver a.g.c. system fell into one of three general series:

No a.g.c.

Simple a.g.c., where the control voltage is obtained from the negative component developed across the detector load resistor. (Fig. 5A.)

Voltage-doubler a.g.c., using a diode to rectify the composite video signal at the output of the amplifier, and adding it in series with the simple a.g.c. developed by Ed 2. (Fig. 5B.)

Requirements for a good a.g.c. have doubt been seen by many

COMPONENT	CHECK POINT	VARIATIONS LOW TO HIGH FREQUENCY	POSSIBLE TROUBLE (If voltage readings are not normal)
6J6	"B+"	+150 v.	C ₁₀ , C ₁₅ , C ₁₁ shorted, the v.h.f.-u.h.f. switch.
	Filament	6.3 v.a.c.	L ₁₁ open, C ₁₄ , C ₁₃ shorted.
	R ₃	-20 v. to -3 v.	R ₃ open, C ₁₂ shorted. L ₁₀ open or shorted.
	R ₂	± 1.5 v. to ± 2.6 v.	Crystal defective, L ₇ shorted to chassis, C ₇ shorted. Voltage polarity depends upon crystal polarity.
D ₁ Mixer Crystal	Current through R ₁ . Insert milliammeter	0.6 through 3.7 to 1 ma.	D ₁ defective, C ₄ shorted, L ₈ open.

Table 1. Troubleshooting data for the Emerson u.h.f. tuner.

television technicians but, more often than not, not understood. To give examples of two extremes, when a technician installed a receiver in a strong

signal area, the picture would become extremely contrasty and, on some receivers, there would be a complete loss
(Continued on page 114)

Table 2. Alignment procedure for the video i.f. and sound circuits of the Emerson 120174B chassis.

VIDEO I. F. ALIGNMENT

EP	SIGNAL GENERATOR FREQUENCY	CONNECT TO	OUTPUT INDICATOR	CONNECT TO	ADJUST	REMARKS
1	45.75 mc. un-modulated	Floating shield of converter tube V ₂₃ (6J6)	V.T.V.M.	Video test point D	T ₄ for maximum reading	Adjust output of signal generator so that maximum response does not produce more than -2 v. d.c. on V.T.V.M.
2	43.2 mc. un-modulated	Same as above	Same as above	Same as above	T ₃ for maximum reading	
3	42.0 mc. un-modulated	Same as above	Same as above	Same as above	T ₂ for maximum reading	
4	45.0 mc. un-modulated	Same as above	Same as above	Same as above	L ₃ , T ₁ for maximum reading	
5	41.25 mc. un-modulated	Same as above	Same as above	Same as above	L ₂ for minimum reading	Increase output of signal generator
6	47.25 mc. 400 cycles amplitude modulated	Same as above	Oscilloscope gain near maximum; horizontal sweep at 400 cycles	Same as above	L ₁ for minimum vertical deflection	Set signal generator at maximum output
7	44 mc. center frequency. 10 mc. sweep. Marker generator at 45.75 mc.	See Fig. 8	Oscilloscope	Same as above	T ₄ for waveform below	Set signal generator output as low as possible

SOUND ALIGNMENT

8	4.5 mc. un-modulated or tune to on-the-air TV channel	Pin 7 of V ₄ (through .01 μ fd. condenser)	V.T.V.M. (through 10,000-ohm resistor)	Junction of C ₃₀ , R ₃₅ , and R ₃₆	T ₅ top or bottom for maximum reading. T ₆ top and bottom for maximum reading	Adjust signal generator output (or antenna coupling) to produce a 1-volt d.c. rise on meter. If using signal generator short pin 1 of V ₃ to chassis
9	Same as above	Same as above	Same as above	Junction of R ₄₄ and C ₃₄	T ₇ secondary for maximum negative reading	T ₇ secondary adjustment is on top for part #708018, #708151; on bottom for part #708017
10	Same as above	Same as above	Same as above	Same as above	T ₇ primary for maximum negative reading	
11	Same as above	Same as above	Same as above	Same as above	T ₇ secondary for zero d.c. reading	

4.5 MC. VIDEO TRAP

12	4.5 mc. un-modulated	Pin 2 of V ₅ (through .01 μ fd. condenser)	V.T.V.M. (negative scale)	Junction of R ₃₄ , T ₆ , and C ₂₉	L ₈ for minimum negative reading	Short pin 1 of V ₃ to chassis. Set contrast control completely counterclockwise. Re-peak T ₅
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SIX-METER EMERGENCY TRANSCEIVER

By

ROBERT L. HANKEY, W3OBC

and

MAURICE P. JOHNSON, W3TRR

WAAM (TV) Engineering Dept.

THE DESIGN of most emergency amateur equipment, portable gear intended to be carried by hand in particular, is necessarily a compromise dictated by the unyielding demands for lightweight, small size, and low battery drain. Naturally this results in simple receivers and low power transmitters. To obtain any degree of reliable communication between such units, the choice of operating frequency warrants careful consideration.

Persons aware of current trends in emergency equipment probably already realize that the six-meter band is being favored as the band best suited to this type operation. Six meters gives satisfactory coverage, yet is not cluttered with the QRM so typical of the more active lower frequencies. Reasonably efficient designs for six-meter gear are possible with conventional components and without complex circuitry, since the band is within the frequency ratings of most miniature tubes. Another point of amateur interest is the antenna efficiency which can be obtained with reasonable antenna lengths.

For these and other reasons the FCDA prefers six meters for *RACES* (Radio Amateur Civil Emergency Service) use rather than the more popular ten-meter band. Local coverage is likely to be more reliable because "six" is less frequently bothered by DX interference, which can be a serious factor. The FCDA's plan for "matching funds" to supplement community expenditures for CD radio does not allow for the setting up of new ten-meter systems, although it does allow for replacement and growth in existing systems. A community about to set up a *RACES* system, or an existing system wishing to add a network of hand-carried portables, would do well to consider six meters.

The six-meter, hand-held transceiver discussed here is the first of several equipment designs being un-



Above, the six-meter transceiver with its antenna. Controls are "tone-voice" switch, regeneration, and battery "on-off." Small hole is for receiver tuning. At right, one of the transceivers is shown in operation.



The six-meter amateur band has advantages in equipment and performance over both "ten" and "two" for CD and other portable-emergency work.

dertaken to provide a complete portable and emergency service, and is thus well suited to Civilian Defense needs. This transceiver meets the demands for a compact, lightweight, battery-powered unit, entirely self-contained, intended for use at locations that would be inaccessible to mobile or other equipment.

As six meters had been selected as the most promising band for the equipment, considerable effort was directed toward an efficient transceiver design. Previously published material was carefully perused, and several worthwhile ideas gleaned, but no design was encountered which completely met our requirements. It was therefore decided to establish our own design criteria, and make trial constructions and tests to check the various circuits examined.

Ordinary modulated oscillators and superregenerative receivers were combined in some of the simplest transceiver designs and a test of such a circuit was made. A two-tube set was constructed, one tube for the oscillator and detector, the other as modulator and audio amplifier. The circuit adapted itself to extremely compact construction and low battery drain, but the faults inherent in its simplicity did not permit the unit to meet our specifications. The transmitter proved to be much too unstable for dependable fixed-frequency reception, and the superregenerative detector produced excessive radiation. Body-capacity effects on the antenna affected stability to a great degree, which was considered especially undesirable in a hand-held transceiver.

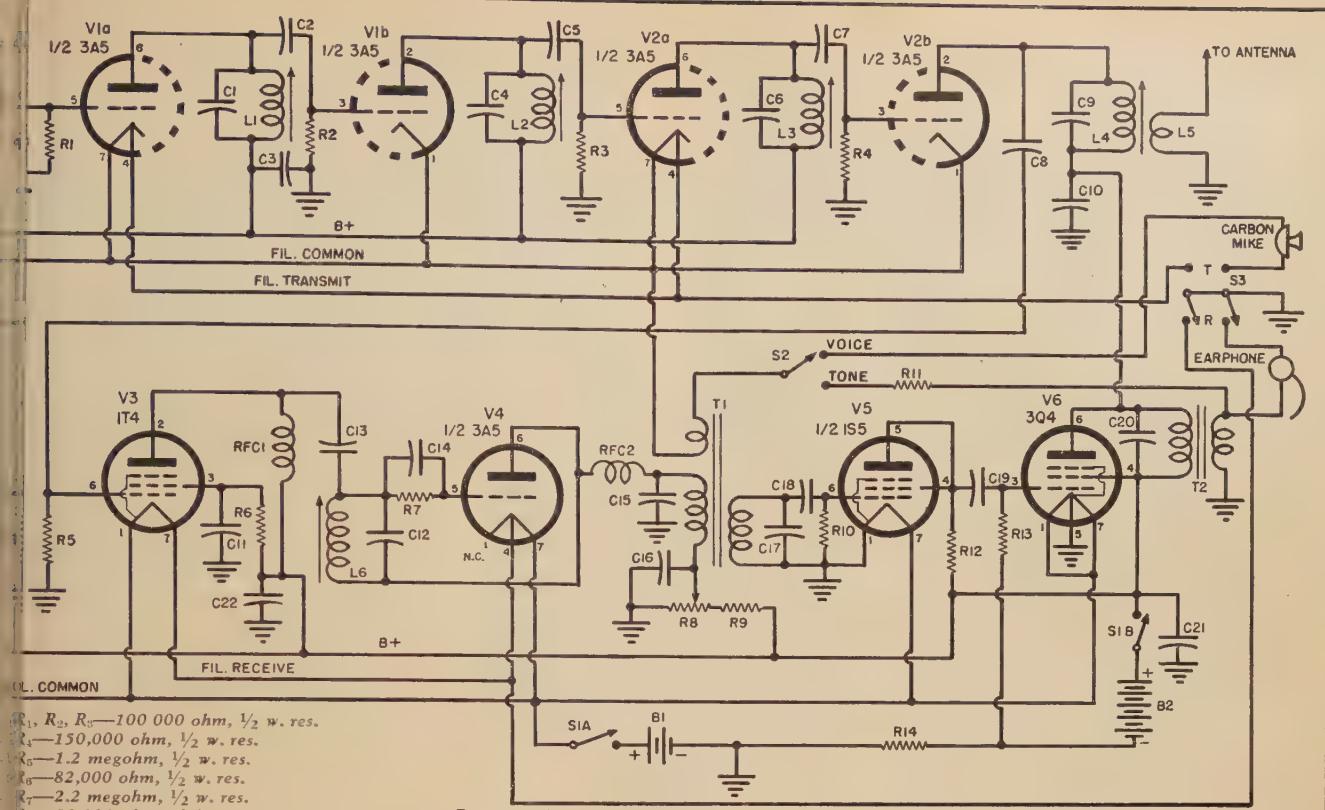
These tests of the simplest transceiver circuits indicated that somewhat more refined circuitry would be necessary if any degree of reliability was to be obtained.

The circuit which finally evolved after considerable study, test, and discussion is a carefully balanced combination of the features needed to provide the desired stability and dependability without undue weight or battery drain. As the design of the prototype units progressed, every effort was made to avoid special, subminiature, or surplus parts, so that duplication could be more easily accomplished.

Our contemplated six-meter project is based upon single-frequency work-type operation, with transceivers intermingled with other mobileable and fixed station equipment, with the majority of receivers intended for fixed-frequency operation. Therefore, crystal control of the transmitter became almost mandatory in the interest of frequency stability. Harmonic-type oscillator circuits were rejected in favor of a conventional triode oscillator with multiplier stages, since the latter was considered somewhat less difficult to adjust and maintain.

Four stages in the r.f. lineup make use of two dual-triode tubes, multiplying the crystal frequency eight times to produce the six-meter carrier. The oscillator plate circuit tunes to the crystal frequency, with each following stage functioning as a doubler. Operating the final amplifier as a doubler admittedly reduces the efficiency, but this slight sacrifice is well worth the necessity of neutralization.

A receiver of comparable performance



R_1, R_2, R_3 —100,000 ohm, $\frac{1}{2}$ w. res.
 R_4 —150,000 ohm, $\frac{1}{2}$ w. res.
 R_5 —1.2 megohm, $\frac{1}{2}$ w. res.
 R_6 —82,000 ohm, $\frac{1}{2}$ w. res.
 R_7 —2.2 megohm, $\frac{1}{2}$ w. res.
 R_8 —50,000 ohm miniature pot
 R_9 —10,000 ohm, $\frac{1}{2}$ w. res.
 R_{10} —10 megohm, $\frac{1}{2}$ w. res.
 R_{11} —27,000 ohm, $\frac{1}{2}$ w. res.
 R_{12} —47,000 ohm, $\frac{1}{2}$ w. res.
 R_{13} —470,000 ohm, $\frac{1}{2}$ w. res.
 R_{14} —270 ohm, 1 w. res.
 C_1 —50 μ fd. ceramic cond.
 C_2, C_5, C_7, C_{22} —100 μ fd. ceramic cond.
 C_3, C_{10}, C_{17} —680 μ fd. ceramic cond.
 C_4 —15 μ fd. ceramic cond.
 C_6, C_9, C_{12} —5 μ fd. ceramic cond.
 C_8 —10 μ fd. ceramic cond.
 C_{11}, C_{20} —.001 μ fd. disc ceramic cond.
 C_{13}, C_{14} —50 μ fd. ceramic cond.
 C_{15} —.002 μ fd. disc ceramic cond.
 C_{16} —.25 μ fd., 200 v. miniature cond. (Aerovox P-282)

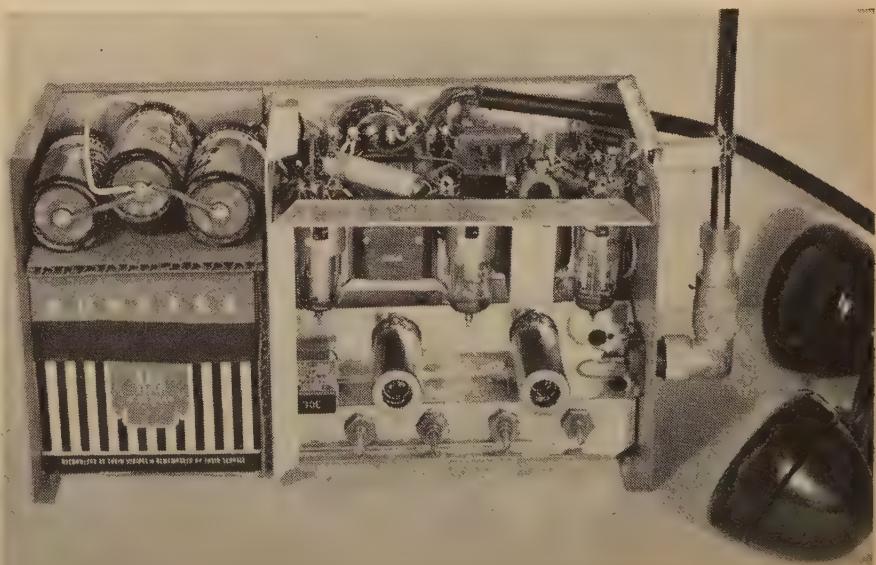
C_{15} —.01 μ fd., 200 v. miniature cond. (Aerovox P-832)
 C_{19} —.01 μ fd., 200 v. miniature cond.
 C_{21} —10 μ fd., 150 v. elec. cond. (Aerovox SRE Bantam)
 RFC_1, RFC_2 —7 phy. r.f. choke (Ohmite Z-50)
 L_1 —30 t. #26 en.
 L_2 —24 t. #24 en.
 L_3 —13 t. #20 en.
 L_4 —8 t. #16 en.
 L_5 —2 t. hookup wire, wound over cold end of L_4 (output link)
 L_6 —8 t. #16 en.
 Note: All coils $\frac{1}{2}$ " dia., $11/16$ " long, wound on National XR-50 forms. (Turns spaced to fill winding space)
 $S_{1A}-S_{1B}$ —D.p.s.t. toggle sw.
 S_2 —S p.d.t. toggle sw.

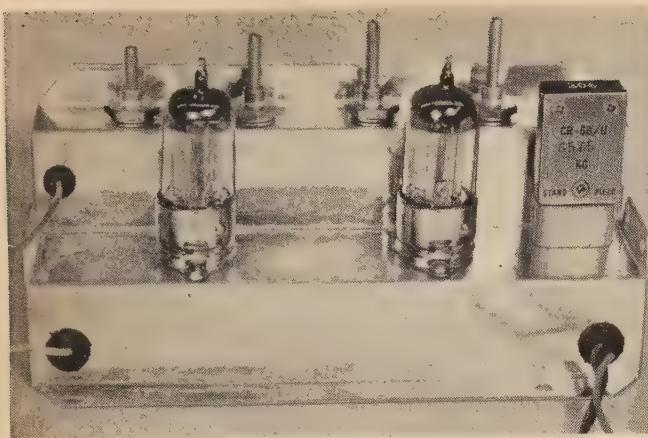
S_3 —Handset sw., modified (see text)
 $Xtal$ —6250 to 6750 kc., determined by desired freq.
 B_1 —Three size "D" $1\frac{1}{2}$ v. flashlight cells in parallel
 B_2 —Two 90 v. batteries in parallel (Burgess N60 or equiv.)
 Carbon mike, earphone—Part of TS-9-AJ telephone handset (see text. Purchased from Telephone Engineering Co., Simpson, Pa.)
 T_1 —Transceiver input trans., 200 and 5000 ohms to 60,000 ohms (Stancor A3833)
 T_2 —Transceiver output trans., 10,000 ohms to 50 and 2000 ohms (Stancor A3836)
 V_1, V_2 — $\frac{1}{2}$ 3A5 tube
 V_3 —IT4 tube
 V_4 — $\frac{1}{2}$ 3A5 tube
 V_5 —1S5 tube
 V_6 —3Q4 tube

Schematic of the six-meter CD and emergency portable transceiver. The two audio tubes are shared by transmitter and receiver; the transmitter output tank coil doubles as an input coil for the receiver r.f. stage, thus eliminating antenna switching. Otherwise the transmitter is distinct from the receiver, unlike the usual tube-sharing "transceiver" circuit.

was the next objective. Examination of the superheterodyne circuit dictated that the inherent complexity for even moderate sensitivity would not be justified in this application. The excellent sensitivity of the regenerative detector makes it worthy of consideration. It possesses a degree of a.v.c. action in itself, and its gently broad bandpass characteristic is particularly objectionable for fixed-tuned receiver on an undesired band. Furthermore, its simplicity lends itself admirably to a compact construction such as this. The triode circuit was found to provide the smoothest performance in particular unit. One-half of a was finally used as about the only available. Control R_8 is the regeneration control, made variable to allow adjustment for battery voltage changes, and to permit optimum detection operating adjustments. The values V_1 , R_7 , and C_{15} all affect the operation and the listed values were those which gave best results in this circuit.

A view of the transceiver with the cover removed and antenna attached. The transmitter and receiver occupy separate chassis, simplifying construction. The receiver is intended for fixed-frequency use and is slug-tuned through a hole in the case.





The transmitter chassis, showing small size and simplicity of the unit. Grommet at upper left carries the antenna lead; the other is for receiver input. Modulator is on receiver chassis.

The primary objections to the super-regenerative detector, namely oscillator radiation and antenna loading effects, were remedied in this receiver by incorporating an r.f. stage to isolate the detector from the antenna. A pentode amplifier is used which helps to increase the sensitivity of the receiver.

The use of an antenna changeover relay or switch was avoided in a practical and convenient manner. Coil L_4 , together with C_9 , serves the dual role of tank circuit for the transmitter final and also tuned input for the receiver. Condenser C_8 and R_5 form the receiver coupling, and by proper choice of values very little energy is lost when transmitting.

The requirements of the modulator and receiver audio amplifier were easily combined in a common circuit using two tubes. One winding of a dual-purpose input transformer couples the detector to a pentode voltage amplifier. The other primary introduces the single-button carbon mike when transmitting. The button current is drawn from the filament string. Contact bias on the voltage amplifier produces excellent gain in the stage, which is RC -coupled to the power output tube. The output transformer secondary matches the tube to the

receiving earphone, and the primary is used for the Heising modulator.

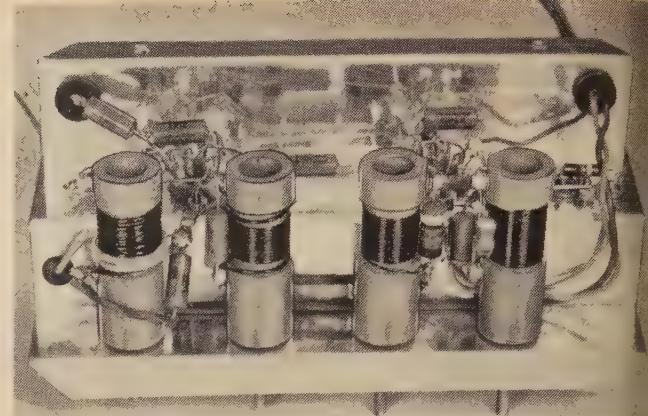
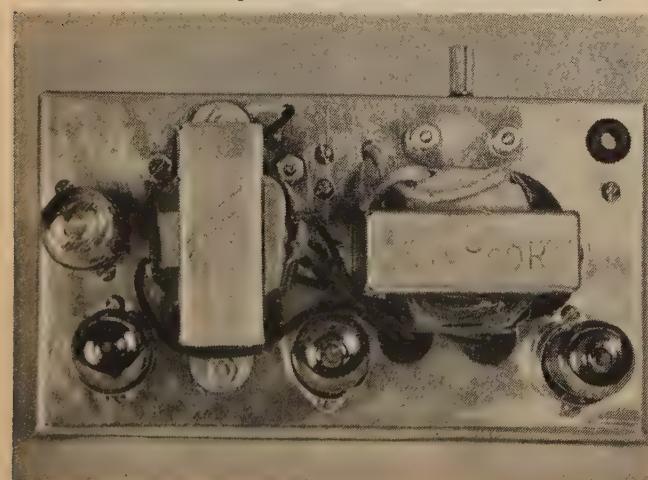
The selector switch S_2 injects a side-tone which makes a very convenient modulating signal for alerting or tuning the receiving station. Proper phasing of the windings in the feedback loop is essential to generate the tone.

The power changeover for "transmit-receive" switching is accomplished by S_3 . Half of this d.p.d.t. switch completes the ground path for the filaments of each section as required, while the other half completes the mike or earphone circuit, depending upon the use. The dual-purpose audio section operates continuously as it functions during both reception and transmission.

The advantages of having this push-to-talk changeover incorporated as a switch in the handset were obvious. Several TS-9-AJ handsets with butterfly switches were available, and these were carefully rebuilt as d.p.d.t. switches by using thinner insulating spacers and adding two switch leaves. The "receive" contacts were adjusted to be normally closed. A length of four-wire cable with a shield for the ground return was connected from the handset to the transceiver proper.

Should this handset revamping be

Top view of the receiver and audio section. The transceiver transformer is at left; output/modulation transformer at right. The tubes, left to right, are the 1T4, 3A5, 1S5, and the 3Q4.



Under-chassis view. Oscillator at right operates on crystal fundamental; all other stages, including final, are doublers. Parts are standard. Chassis is cut from a transcription disc.

considered too laborious to the constructor, the same electrical result can be accomplished by mounting a spring-return switch on the transceiver within easy reach of the carrying handle.

The handset clips into the carrying handle when not in use. This handle is a U-shaped bracket which is folded from $\frac{1}{16}$ -inch aluminum stock in such a manner as to grip the handset snugly.

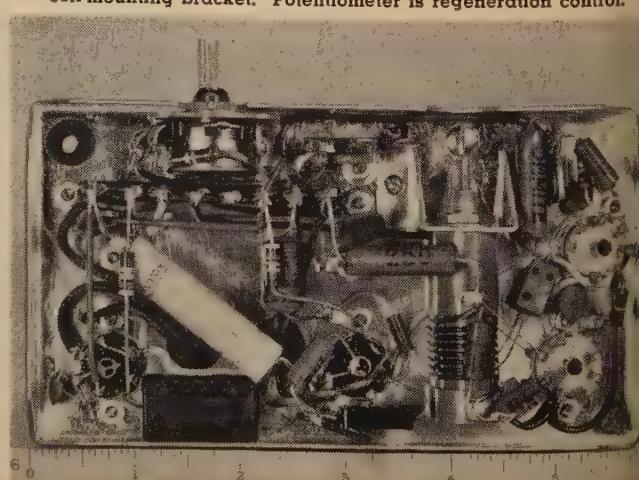
The controls on the front panel are the regeneration control, the "tone voice" switch, the battery "on-off" switch, and an access hole for tuning the receiver slug. The antenna mount on the front end of the cabinet allows, if desired, a terminal strip can be included for external battery connections.

It is suggested that a careful study of the schematic, photographs, and sketches be made before duplication of the transceiver is undertaken. The parts layout and method of construction will be evident from the photos. Careful adherence to the layout and listed parts is suggested to circumvent unnecessary complications in assembly.

The entire rig is fitted into a BCU-2110 "Minibox," measuring 6" x 11"

(Continued on page 77)

Receiver and audio section under-chassis view. Ceramic sockets are used for the r.f. amplifier and detector tubes. Note the coil-mounting bracket. Potentiometer is regeneration control.



DAPTING V.O.M. AS A FIELD STRENGTH METER

By ELBERT ROBBERSON

TRANSMITTER workers, both amateur and professional, have long known that the *field strength meter* is better for tuning up output and antenna circuits than antenna ammeters, plate milliammeters, or any single instrument. All too often, however, it is not used—either because one is unavailable for some reason or because it would represent one more bulky object to be added to the already heavy load of instruments and tools to be carried to the

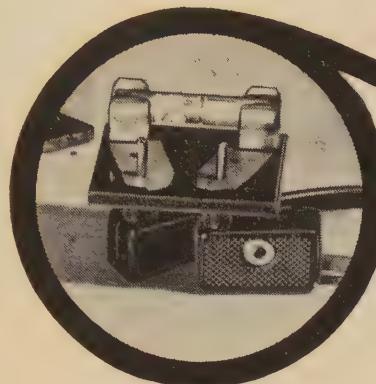
The photograph at right above shows the adapter which will convert the conventional volt-ohm-milliammeter normally carried by a technician, into a sensitive field strength meter which will give accurate relative measurements of actual radiated power on any frequency up to thousands of megacycles.

The sensitivity may be judged from the fact that the pointer of the instrument in the photograph is being deflected $\frac{1}{3}$ of full scale, or about 68 microamperes, by the relatively feeble amount of power being generated (in this case on 50 megacycles) by a grid oscillator in the same room.

The adapter requires no power source, weighs only one-half ounce, can be tucked away in the meter-lead compartment of the instrument, and, best of all, it can be made in minutes from surplus and scrap.

The general aspect is shown in the photograph above (left). The heart of the adapter is a 1N21 radar crystal, used as a detector. The mechanical design of the adapter connects the crystal across the meter input, in parallel with the normal leads, which are used as pickup dipole antenna. Since the length of the leads determines the resonant frequency of the detector, a pair may be used for any particularly important frequency, or they may be tuned by rolling them up, or coiling onto other nearby metallic objects to add length to the antenna.

The simplest mounting base is one of the Bakelite fuse strips found in every major surplus equipment store. One of the pairs is sawed off, leaving enough Bakelite on one side so that it will cover the input jacks. Two strips of thin brass stock (photograph) are cut to the approximate size shown, and fastened under the clips. Two holes one size smaller than the exact diameter of the meter jacks are drilled through the strips and the Bakelite, and the brass strips slit as shown so they form



A common volt-ohm-milliammeter is quickly converted to a sensitive field-strength meter by connecting a crystal diode across the input terminals by a simple adapter. Meter leads plug through the adapter, securing it and providing an antenna.

This simple adapter converts a transmitter technician's v.o.m. into a field-strength meter for on-the-spot checks.

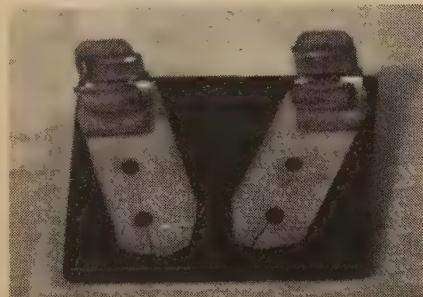
spring contacts. The holes in the Bakelite are reamed slightly so the plugs fit snugly. The hole spacing should be exactly the same as that in the meter, so the plugs will fit through the adapter holes and into the meter jacks.

The cartridge-like rim on the end of the surplus crystal is then filed off, and a piece of $\frac{1}{4}$ " rod, either brass or aluminum, is then cut to make up the length between the fuse clips, and is drilled in the end to take the crystal tip. The extension is slipped onto the tip, and the assembly is clipped into the holder, just like a fuse.

Of course the crystal must be clipped in with the correct polarity to make the meter read properly.

If it is desired to make use of the later model crystals with pigtail leads,

The fuse clips and brass contact strips are mounted as shown. Strips are slit for "spring" effect for positive contact.



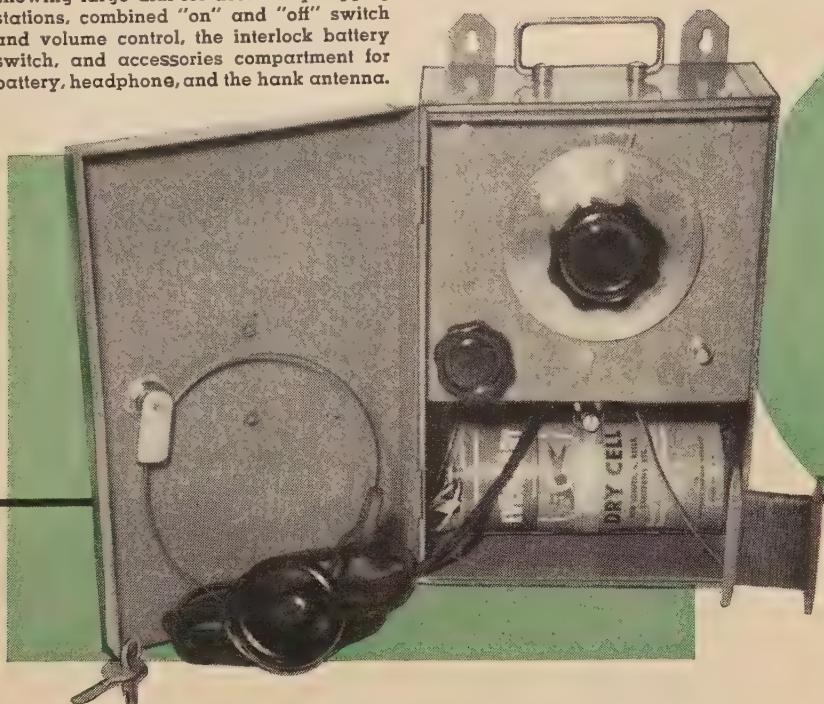
solder lugs may be substituted for the fuse clips, and the crystal mounted between them.

In the field, the test leads and the adapter are plugged into the meter, the selector switch set on the microampere position, care being taken, if transmitter power is high, not to "pin" the meter. If pickup is too great for safety to the meter, the leads may be shortened or rolled up. If insufficient pickup is obtained, the leads may be connected to other metal objects.

The meter should be placed as far away as working area and vision permit so that movements of the operator will not affect the indications and in order that direct pickup from the transmitter is minimized. An example of correct placement would be the case of tuning a small boat transmitter, with the meter placed in sight of the operator on the stern of the boat or preferably, on the dock. With transmitters located on dry land the possibilities for placement of the meter are virtually unlimited, and fences, automobiles, trees, etc., may be used to support or augment the antenna.

With correct placement and a proper pickup circuit, excellent comparisons may be made for tuning transmitters of as little as five watts' output. The adapter can be used with any instrument having a microampere or sensitive low-voltage scale.

Fig. 1. External view of the security radio showing large dial for accurately logging stations, combined "on" and "off" switch and volume control, the interlock battery switch, and accessories compartment for battery, headphone, and the hank antenna.



A HOME SECURITY RADIO

By
H. G. BOURNE and E. J. CORDIER
Ohio Department of Health

A rugged, four-tube superhet which combines good sensitivity with long battery life—insuring reliable emergency service.

"THE fear reaction of military personnel who were not acquainted with the technical details, atomic bomb, was appalling at Bikini and Eniwetok. The fear reaction of the uninitiated civilian is ever evident. It is of such magnitude that it could well interfere with an important military mission in time of war." So states the Army Medical Department in the publication "What You Should Know About the Atomic Bomb."

One of the major causes of panic is fear. Terror of the unknown promotes disorganized behavior. By predisaster education and training, the threat of unknown or fantastic dangers may be diminished. During the emergency or danger situation itself, and for several hours to a day or more thereafter, other factors such as rumor, suggestibility in contrast to critical judgment, imitative behavior (people run when others run), and tension and insecurity will continue to operate to produce panic.

Civil defense authorities may inform the individual, stimulate leadership, dispel fear, and explain the procedure one must follow to satisfy basic needs such as hunger and safety if a means is available for communication with each household. How can this panic-decreasing information be conveyed

to the individual in the absence of telephone service and failure of conventional broadcast receivers subject to community electric service?

There are those who have counseled that aircraft, taxis, and police cars already equipped with radio receivers be provided with a public address system to soundcast information and instruction. Such a procedure limits the broadcast information to short disconnected phrases such as "Boil water!" "Stay indoors!" "Keep off the roads!" Such brief pronouncements containing a modicum of truth in the absence of explanation may be elaborated, distorted, misinterpreted, mangled, and constantly magnified with each retelling until they contribute to hysteria.

Moreover, loud noise as from a public address system may, in conjunction with other sounds, directly contribute to panic. Caldwell *et al* state "In a disaster people may hear the loud noise, smell objects burning, and see people running. These sensory stimuli heighten excitement and contribute to panic behavior." Schmidberg² in describing British experience has stated "Auditory impressions in war exercise the strongest effect of all on nerves. The whistling of falling bombs, the sounds of their explosions, and the boom of the antiaircraft guns

mingle in the inferno of noise with shattering effects on the nerves."

Others have recommended battery-operated portable broadcast-band receivers of the vacation type or automobile radios as a means of communicating with householders. In each household, however, unless leadership is maintained, the collective behavior of the group will be panic in type. To maintain leadership, civil defense communications affecting the family unit should be directed exclusively to the family head. This privacy of communication is defeated by a speaker-equipped vacation or automobile receiver. Moreover, World War II collections suggest in the event of future conflicts the majority of vacation receivers will be inoperative because batteries are unobtainable. A automobile receiver is a heavy drain on the car storage battery. And, a dead battery is poor preparation for flight if evacuation is ordered. If the car engine is run to maintain the battery charge, the usual caution to avoid running internal combustion engines in closed garages is likely to be disregarded in time of mental stress and more deaths can be anticipated from carbon monoxide poisoning than lives saved by radio-acquired information. Hence neither personal-type, battery-operated radios nor the automobile receiver provide a satisfactory solution.

A special-purpose, home-security radio of improved sensitivity and powered by a universally available battery is proposed by the authors. One receiver believed to be suitable is described in the hope it may stimulate further development and eventual manufacture for public service.

There are now available to the public portable radios that are inexpensive and of simple operation; such features pose no special problem. Re-

ity may be secured through the use of quality components adequately protected from the destructive forces of man and nature. Two features of the emergency home receiver, however, require special study, i.e., source power and sensitivity.

Energy Source

The ideal source of energy for a home-security receiver would be a single battery of sufficient capacity and infinite shelf life which could be energized by the addition of tap water or urine. Furthermore it should be convenient size and weight, commercially available everywhere, low cost, and nonspillable. Since no such battery was known to the authors a single No. 6 dry cell was selected as a compromise. The standard No. 6 dry cell will deliver 80-90 per-cent of its original power when placed in use at the end of one year and 50 per-cent at the end of two years. It may be replaced for less than \$1.00 and otherwise appears to satisfy the requirements of an ideal battery.

The useful life of a No. 6 dry cell could obviously be too brief to operate a radio expected by the public to provide entertainment; however, in the event of disaster, a receiver would be emergency service if it was capable of maintaining a schedule of 10 minutes "on," 20 minutes "off" for hours (daylight) and then after an overnight rest the same schedule repeated for a total of three days. The power pack was therefore designed to adapt the energy from a single No. 6 dry cell to the operation of a receiver for three days on this timetable. It remained to construct a receiver to combine minimum battery drain with high sensitivity.

The circuit and components of a vibrator power supply which proved satisfactory are shown as part of Fig. 2. Although commercially available parts were utilized wherever possible, it was necessary to make special choices and to readjust the standard 1.5 volt vibrator driver contacts to assure dependable starting and maximum output voltage and current when operating on 1.5 volts. If the vibrator fails to start on 1.5 volts or the "B" voltage is too low due to poor vibrator action, open the vibrator by carefully sawing around the can about $\frac{1}{2}$ " above the base. Turn the driving contact adjustment screw until optimum operation is obtained. Replace the can and hold in place with plastic vinyl tape.

The audio frequency choke, CH_1 , deserves special attention. The core was that of a standard output transformer similar to that used as the vibrator output transformer (Knight 8000/3 ohms—Allied No. 62-093). Any small transformer core will do. It is only necessary to remove the "I" section of the core which opens the "E" section. The winding will then slip off easily. First wrap one or two layers of vinylastic tape on the core, then wind No. 20 d.c.c. enameled wire about the center.

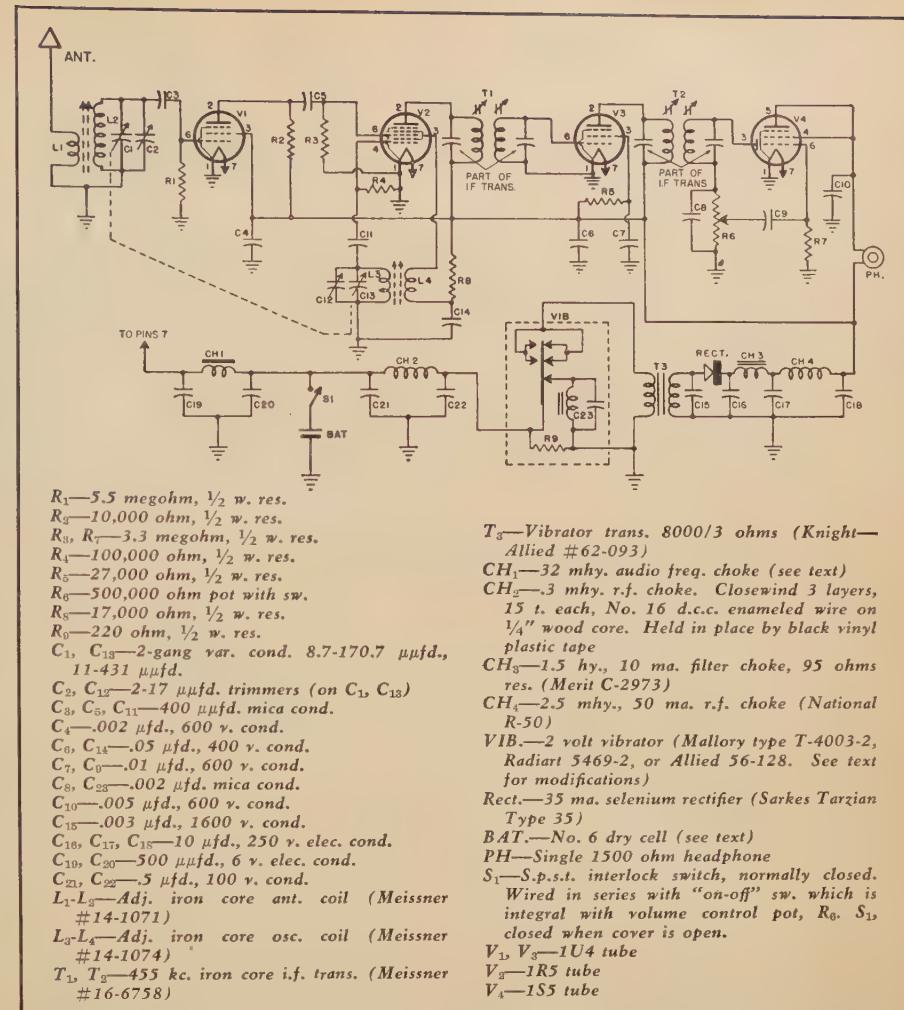
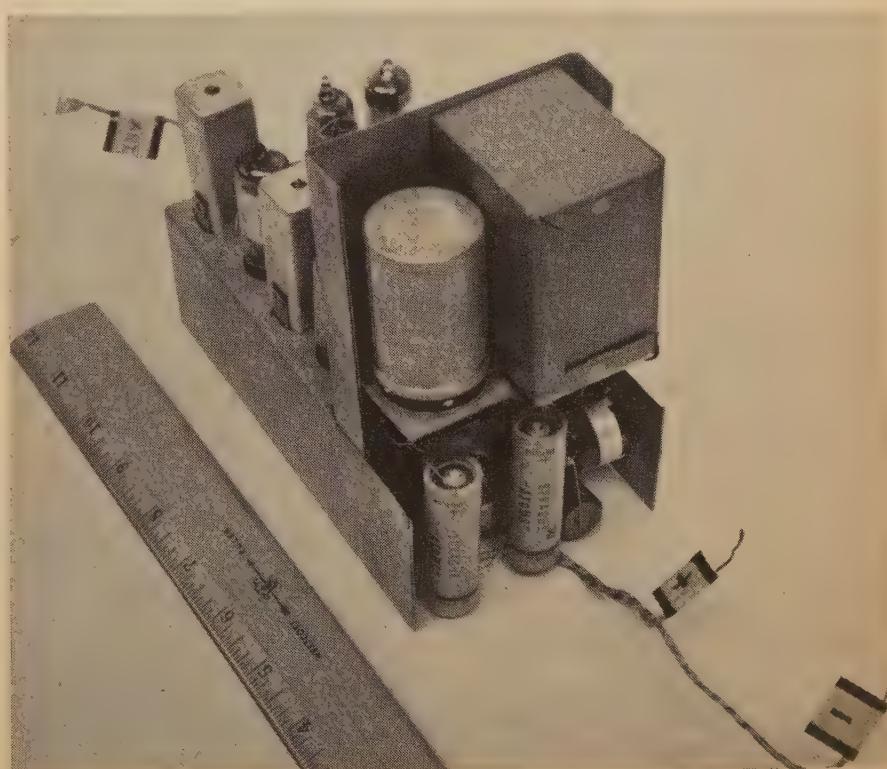


Fig. 2. Complete schematic diagram of the battery-operated "security" radio receiver.

Fig. 3. Internal view showing vibrator power supply mounted on the vertical chassis and receiver proper located on the horizontal chassis. See text for details.



ter leg until the "window" area is full. Replace the "I" section, being careful to make good contact with the "E" section. One must also exercise caution against shorting the wire to the core. The "I" and "E" sections are then held firmly in place by bending the mounting bracket lugs into their former position.

Upon completion of the receiver and its included power pack, trial runs were made to determine the plate potential and current as well as the battery terminal potential as the 10 minutes "on," 20 minutes "off" schedule progressed. After four days of operation the terminal potential of the No. 6 dry cell dropped to approximately 1.2 volts and the vibrator ceased to start.

Sensitivity

The home security radio was designed upon the premise that it must receive, during daylight hours, stations 25 miles or more distant having 1000 watts or less power. Furthermore, the reception must be accomplished with no more antenna than could be located in a cellar or bomb shelter. These specifications are based upon the assumption that metropolitan and suburban transmitters will be silent following an attack for one or more of the following reasons: station destroyed, no power, personnel dead. Elsewhere, silence will be imposed for security reasons except for previously designated transmitters located in the nearest supporting communities. The power output of these outlying stations will be restricted to the minimum necessary to reach the devastated area effectively. Transmissions will proceed during daylight hours in order that the information broadcast can be converted by the family head into appropriate action.

A four-tube superheterodyne utilizing one stage of untuned r.f. amplification was found to be most capable of achieving high sensitivity with low battery drain, portability, operational simplicity, and moderate cost. A similar conclusion was arrived at by Passow³ who also had the problem of obtaining more sensitivity from loop-operated receivers so that they could be used in isolated communities throughout the country rather than only in metropolitan areas.

Portability and Cost

Sufficient portability to permit the receiver being easily moved from the owner's house to a neighbor's, to the automobile, bomb shelter, or garage is desirable. "Pocket size" is considered unnecessary since the family which may be required to evacuate its home will wisely choose to burden itself with no more than food, extra clothing, money, and valuable papers.

The total net retail cost of the components of the single receiver constructed was \$42.50. Quantity buying, construction simplification, and manufacturing "know how" could be ex-

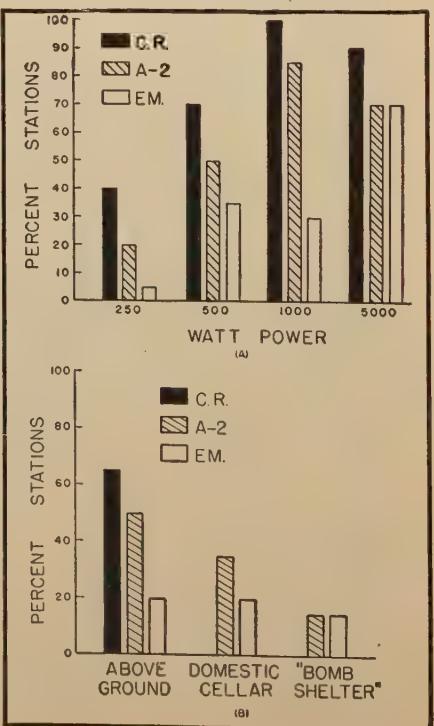
pected to reduce the cost very considerably. However, it is believed that it is far better that many foresighted families make a financial sacrifice to purchase an adequately built unit rather than to have every household be induced by cheapness to buy a worthless product.

General Description

The receiver circuit is a standard superheterodyne employing a 1U4 in an untuned r.f. stage, a 1R5 as oscillator-mixer, another 1U4 in the i.f. stage and a 1S5 as diode-detector and audio-amplifier. Automatic volume control has been omitted and audio-amplification is limited to that of the 1S5 triode since its output is sufficient to operate the headphone. The untuned r.f. stage represents a compromise between the greater sensitivity of a tuned r.f. stage and the necessity of a large 3-gang condenser and other components which would have increased the size, weight, and cost of the receiver.

The chassis consists of two sections as may be seen in Fig. 3. The horizontal receiver member contains on the topside tubes, i.f. cans, and variable condenser while directly beneath are located the usual fixed condensers, resistors, tube sockets, volume control, safety switch, etc. The vertical power supply chassis is inset into and attached to the receiver unit. On the upper portion of the vertical chassis

Fig. 4. (A) Comparative performance of a communications receiver (C.R.), the home security radio (A-2), and a commercial four-tube personal portable (E.M.). "Percent stations" represents the per-cent of b.c. stations within 100-mile radius of test locations which were received in each of four power classifications: 250, 500, 1000, and 5000 watts. (B) Similar comparison with b.c. stations of 1000 watts power or less made at three sites as indicated on graph.



is mounted the vibrator and a mini-can containing the high voltage transformer, rectifier, choke, and filter condensers. Underneath are placed the low voltage filtering chokes and high capacity condensers needed to remove r.f. hash and audio-hum produced by the vibrator. This construction and the use of steel chassis material was found necessary to reduce internal noises to an acceptable level.

An external view of the complete receiver is shown in Fig. 1. The sturdy metal box housing the receiver is 10½ inches high, 7½ inches wide, 4 inches deep and is provided with two mounting ears and a carrying handle. The cover when closed and locked insures against unwarranted use of the radio by inquisitive members of the family. The weight of the entire receiver and accessories is 10 pounds 6 ounces.

Certain other external features merit special mention. An interlock switch is provided which automatically shuts off the battery when the cover is closed. The battery is intentionally conspicuous to remind the set owner that it must be replaced periodically and to facilitate its change. Moreover, since one instinctively associates limited output with a single battery, its prominent location tends to temper the receiver's use. A hank antenna is provided in place of the more usual built-in loop to add a certain convenience to operation, thereby discouraging the radio's use as a casual "plaything." The large dial with vernier enables one to log stations accurately in advance, thereby obviating the necessity of station hunting during an emergency.

Performance

In the absence of suitable laboratory equipment to measure absolute sensitivity, it was necessary to resort to a comparison method in order to evaluate the emergency receiver's performance. In the first test the security receiver (A-2), with 25-foot half-wave antenna placed in a horizontal position six feet above ground, was compared for sensitivity with a commercial communications receiver (C.R.) employing a suitable outside doublet antenna and with a commercial four-tube personal portable radio (E.M.) provided with the usual built-in loop. To make this comparison every broadcast station within a 100-mile radius of the test location was noted and placed in one of four power groups: 250, 500, 1000, and 5000 watts. The number of stations in each power group which each of the three receivers was able to "bring in" during the daytime was recorded and the per cent of the total in each power group calculated. The results are presented in Fig. 4A. This bar graph shows that the A-2 radio could receive considerably more stations than a commercial four-tube vacation portable but less than a commercial communications receiver having a sensitivity of a

(Continued on page 107)

A LOW-COST CRYSTAL CALIBRATOR

By G. L. COUNTRYMAN, W3HH

Crystal calibrators can be expensive, but versatile junior models can be put together at surprisingly little expense.

Six-frequency crystal marker assembled from junk-box parts. The circuit will oscillate at almost any frequency. Over-all cost is low.

STAL calibrators for modern receivers are a "must," especially for operation on net frequencies, but dollars a copy, they become a luxury item. Their use is even more important if older or more moderately priced receivers are used, as the calibration of these sets is seldom too accurate and varies as the component "age." Most receivers will drift several kilocycles in the first 20 or 30 minutes and, if a schedule is to be run on a spot frequency, it is nice to be able to come up "on the nose" if you have forgotten to warm the receiver in advance.

"calibrator" or marker unit by the author is constructed on all aluminum open-end chassis long x 3½" wide x 2" high and has six crystal sockets, four small for ½" holders and two for ¾" rs. The tube is a 6V6, but any de or beam power tube, regular miniature, will be equally satisfy. No power supply is included here is invariably a source of in the shack, and any receiver will supply the low heater current and 5 ma. of high voltage required. The calibrator is to be used with RO, a unit with one crystal can built into a Vector C12-M #3 picture plug-in turret, using a 6AG5, or 6AK5 tube, and the turreted into the calibrator socket of RO. One such unit is shown in photograph on this page. With this of construction, turning the HRO n to either the 100- or 1000- kc. on will operate the marker, as VFO switch is in the high volt-

age lead. The heater supply and high voltage come from the *HRO*. Many receivers have an accessory socket from which power is available.

A simple, foolproof circuit is utilized, one that will oscillate with a crystal of any frequency. Your old friend, the modified Pierce with unnecessary "frills" removed, is shown in the schematic. If only one crystal is used, the socket can be wired in place and the selector switch eliminated. It is not too much trouble to plug in different crystals for different frequencies, anyway. A 100-kc. crystal makes it a true calibrator; other crystals provide calibrated marker points.

The cost is very close to the zero point. Most amateurs will have no difficulty in finding the required parts in their junk boxes: a small chassis, any convenient size; a pentode and socket; one or more crystals and sockets; two 50,000-ohm, $\frac{1}{2}$ -watt re-

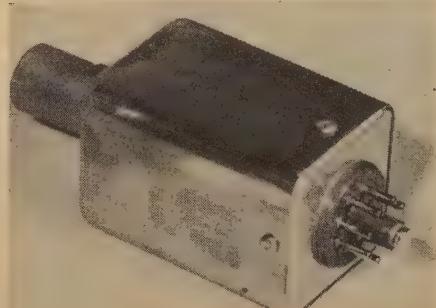
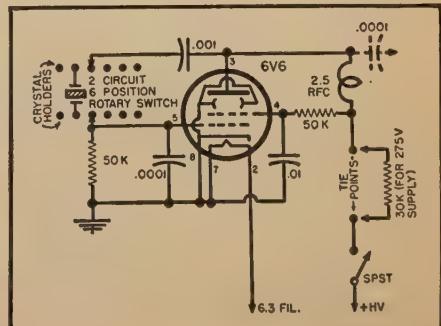
A one-crystal version, using same circuit but eliminating selector switch, was built using a miniature tube and turret socket.

sistors; three mica or ceramic condensers, .01 and .001 μ fd., and .0001 μ fd.; a 2.5 mh. r.f. choke; and a toggle switch are all the parts required. A 2-circuit, 6-position selector switch may be added for extra crystals. A one-watt dropping resistor may be needed if the "B-plus" supply is much higher than 150 volts.

That's all it takes! The high voltage lead in the author's copy was brought to a 2-terminal tie point so that the terminals could either be jumpered, or an appropriate series resistor added, depending on the high-voltage source to be used. With the present high voltage source (a 275-volt supply that operates the monitor) a 30,000 ohm, 1 watt resistor is used to keep the voltage down to the minimum required to insure stable oscillation of the crystal.

It is easy to begin. First look over your crystals, the lower the frequency (Continued on page 133)

Schematic of the low-cost calibrator. It will work with any common pentode, although 6V6 is shown. Receiver supplies the power.



HIGH-QUALITY RECORD REPRODUCTION

AT LOW COST

By FRANCIS H. YONKER

Electronics Lab., Pennsylvania State College

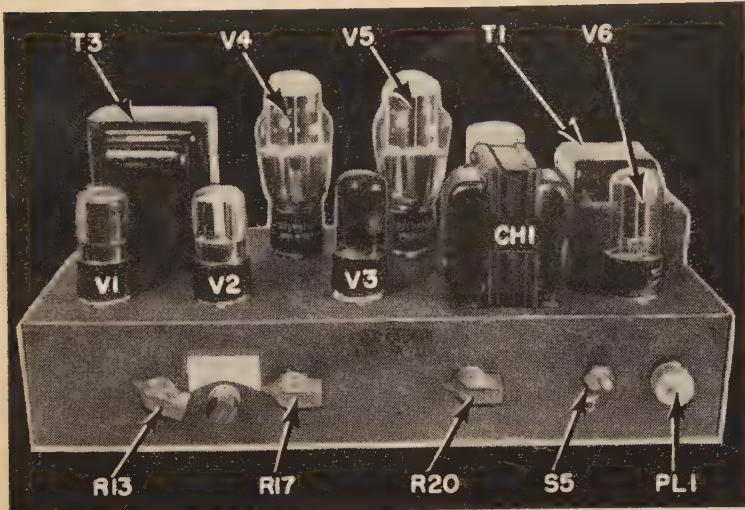


Fig. 1. Over-all view of the home-built amplifier which was especially designed to handle various type phono pickups.

THE components sold for use in today's new high-fidelity circuits cost so much that the average experimenter or music lover can't afford the parts to build the equipment he has read about or seen. The twenty-to thirty-dollar output transformers and the one-hundred-dollar loudspeakers shoo the builder right back to his old equipment.

Fig. 2 is the schematic diagram of an audio amplifier that will match the hi-fi enthusiast's phono pickup whether it be the magnetic reluctance, regular crystal, or the old favorite Brush PL-20, which the author uses for 33½ rpm broadcast transcriptions.

The magnetic pickup preamplifier consists of V_1 , the 6SL7 tube, and its component parts which form a circuit almost identical to the *General Electric* preamplifier. The required compensation for record equalization is built into this circuit but by varying the 6800 ohm input resistor to higher or lower values the frequency response will change.

The next input, "Crystal Pickup," is for those regular phono-arms found on the typical record player. By experimentation and curves obtained using the *RCA* constant tone record #84522-A, the equalizer consisting of a 5 megohm resistor and 67 μfd . condenser was employed.

The final input, "Brush PL-20," was added because so many music lovers have proven in the past that this pickup and the 16-inch broadcast transcriptions equalized by the *Brush* filter cartridge, afford much enjoyment in the way of varied programs of radio broadcast recordings.

Each of these inputs is switched to the amplifier by the rotary switch $S_1-S_2-S_3$. The first half of V_2 , 6SL7,

is necessary for amplification of inputs except for the reluctance pickup, whose preamplifier output is sufficient to drive the second half of V_2 directly via the tone control circuit. The treble control, 100,000 ohms, and bass control, 200,000 ohms, with their associated condensers, introduce considerable loss but the preamplifiers have sufficient gain to overcome this attenuation.

The second half of V_2 is an ordinary amplifier with negative feedback incorporated by omitting the cathode by-pass condenser.

V_3 , a 6N7, is a straight-through amplifier and phase inverter which also contains negative feedback of the same form described previously. The 6N7 tube characteristics allow a greater voltage swing output without distortion than other smaller tubes such as the 6SN7, and also allows operation on the more linear portion of its characteristic curve.

The push-pull output stage, consisting of two 6B4 tubes, gives that preferred triode low plate resistance with less distortion and smaller transformation ratio to the low loudspeaker impedance. The output transformer is a low-cost *Thordarson* 25-watt T-22S70 unit. The transformer does not have a flat response curve up to 20,000 cycles but why care too much about its high-frequency efficiency when adjustment of the tone controls will allow greater signal input to the output transformer at the "fall off" frequency to make up for the transformer loss.

The beauty of this amplifier lies in the availability of bass and treble tone control. Reference to Fig. 3A shows the actual frequency response when the controls are set as indicated.

It's possible to make the record sound like accentuation of high or frequencies, complete loss of one or the other, or a combination near middle range of controls allowing small adjustment to satisfy the individual ear. Any way, the next low to hear your "set-up" is going to be some other combination of controls. Pointer knobs and dial plates will aid in setting controls for exact reproduction of the many different phonograph record characteristics.

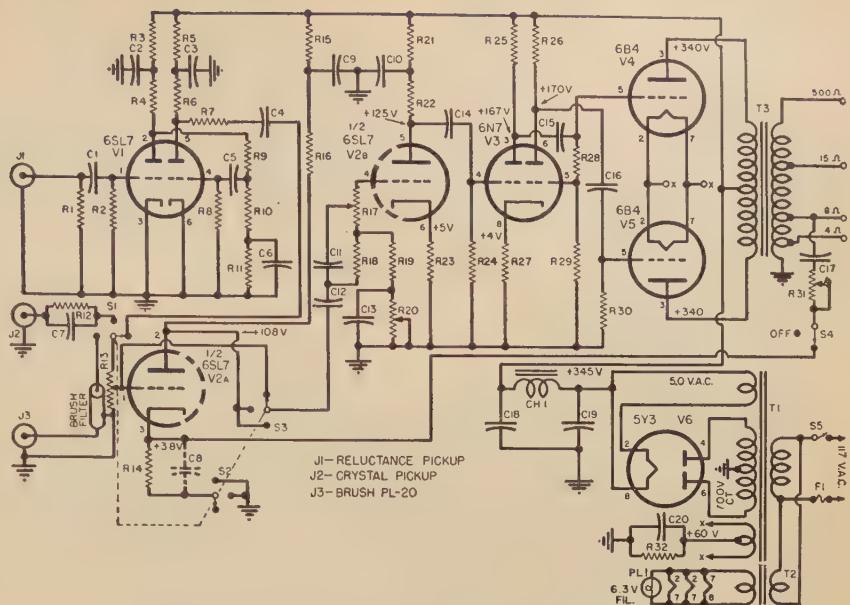
It's true one can make much more elaborate amplifiers with switchable equalizers for every type record on the market but since each individual likes music to suit his own taste, can be adjusted by this tone-control combination to satisfy the conditions.

Switch S_4 is added for those who like to experiment with feed-back voltage direct from the loudspeaker winding. The frequency response curves of Fig. 3A and 3B were obtained with this feedback switch in the "Off" position. By adjusting it throughout its range, where oscillation or motor-boating does not occur, one will find much in the way of entertainment by listening to tone combinations that are produced.

The builder used a 25-watt, 12-speaker as a woofer and installed a separate 5-inch tweeter directly above it. The speaker combination is mounted in a bass reflex cabinet to specifications given in "Data-File 2" in the June 1952 issue of *RADIO & TELEVISION NEWS*.

EDITOR'S NOTE: In order to keep the cost of this unit low, the author has built a preamp, amplifier, and power supply on a single chassis. Where cost is no object, readers are referred to "The Radio & Television News Preamp" (Nov. 1952) and "The Williamson Amplifier" (Feb. 1953) for circuits capable of excellent performance.

R₁—6800 ohm, 1/2 w. res.
 R₂, R₈—3.3 megohm, 1/2 w. res.
 R₃, R₄—68,000 ohm, 1 w. res.
 R₅, R₆—33,000 ohm, 1 w. res.
 R₇—68,000 ohm, 1/2 w. res.
 R₉, R₁₁—180,000 ohm, 1/2 w. res.
 R₁₀—27,000 ohm, 1/2 w. res.
 R₁₂—5 megohm, 1/2 w. res.
 R₁₃—2 megohm pot. ("Volume Control")
 R₁₄, R₂₇—1500 ohm, 1 w. res.
 R₁₅, R₂₁—22,000 ohm, 1 w. res.
 R₁₆, R₂₂—56,000 ohm, 1 w. res.
 R₁₇—100,000 ohm pot. ("Tone Control")
 R₁₈—100,000 ohm, 1/2 w. res.
 R₁₉—4700 ohm, 1/2 w. res.
 R₂₀—200,000 ohm pot. ("Tone Control")
 R₂₃—1800 ohm, 1 w. res.
 R₂₄—270,000 ohm, 1/2 w. res.
 R₂₅, R₂₆—130,000 ohm, 1 w. res.
 R₂₈, R₃₀—240,000 ohm, 1/2 w. res.
 R₂₉—10,000 ohm, 1/2 w. res.
 R₃₁—50,000 ohm pot. ("Feedback Control")
 R₃₂—750 ohm, 10 w. wirewound res.
 C₁, C₅—.05 μ fd., 400 v. cond.
 C₂, C₃—.2 μ fd., 600 v. cond.
 C₄—.02 μ fd., 400 v. cond.
 C₆—.01 μ fd., 400 v. cond.
 C₇—67 μ fd. ceramic cond.
 C₈—20 μ fd., 25 v. elec. cond. (used only if feedback is eliminated)
 C₉, C₁₀, C₁₂, C₁₃, C₁₄, C₁₅, C₁₆—.06 μ fd., 600 v. cond.
 C₁₁—124 μ fd. ceramic cond.
 C₁₇—.25 μ fd., 400 v. paper cond.
 C₁₈, C₁₉—40 μ fd., 450 v. elec. cond.
 C₂₀—30 μ fd., 150 v. elec. cond.
 T₁—Power trans. 350-0-350 v. @ 200 ma; 5 v. @ 3 amps.; 6.3 v. c.t. @ 6 amps. (Thordarson T-22R07 or equiv.)



T₂—Fil. trans. 6.3 v. c.t. @ 3 amps. (Thordarson T-21F10 or equiv.) Ground one side of secondary.

T₃—Output trans. 5000 ohms plate-to-plate (Thordarson T-22S70 or equiv.)

CH₁—12 hy., 100 ma. filter choke (Thordarson T-20C53 or equiv.)

F₁—Line fuse

S₁-S₂-S₃—3-pole, 3-pos. rotary wafer switch

S₄—S.p.d.t. switch ("Feedback")

S₅—S.p.s.t. switch ("Power")

PL₁—Brush filter unit (for Brush PL-20 pickup)

J₁, J₂, J₃—Closed circuit phono jack

V₁, V₂—6SL7 tube

V₃—6N7 tube

V₄, V₅—6B4 tube

V₆—5Y3 tube

Fig. 2. Circuit diagram and parts list covering a low-cost audio amplifier which uses standard, easily-available components.



Fig. 3. (A) Amplifier response with various positions of tone controls. Note particularly that where "maximum" and "minimum" is shown reference is made to the physical position of tone controls and not to response. In operation there is an interaction between bass and treble circuits. (B) Over-all amplifier response with tone control circuit out. Input is at the crystal phono jack. Power output is 9.3 watts.

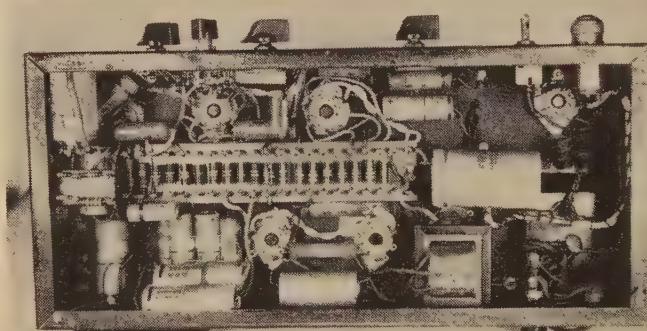
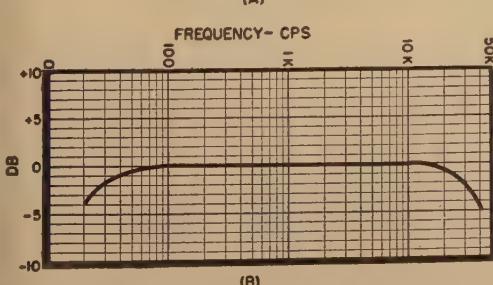
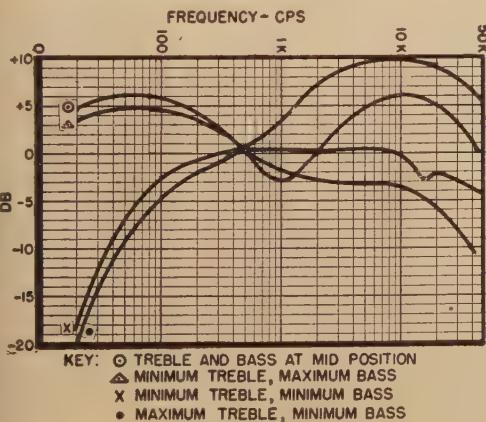
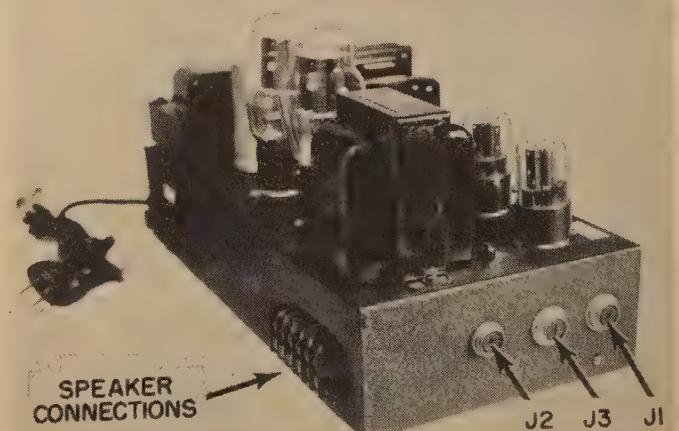


Fig. 4. Under chassis view shows terminal-board construction of unit.

Fig. 5. Side view of amplifier showing location of phono pickup jacks.



Mac's RADIO SERVICE SHOP

By JOHN T. FRYE



THE FIELD STRENGTH METER

THAT DOES IT!" Barney suddenly snapped as he threw down the tools he had been using in an attempt to adjust the linearity of a TV set. "I'm going to find what's causing that interference or know the reason why!"

Mac, his boss, cocked a sympathetic eye at the face of the picture tube. The test pattern on it was moving steadily downward. By adjusting the vertical hold control the boy could make the picture frame correctly for a few seconds at a time, and then a dark, inch-wide band of interference could be seen moving slowly from the bottom to the top of the pattern. When this line reached the top, however, it replaced the blanking bar there, and then the picture started sliding down again.

"It'll be a good trick—if you can do it," Mac commented skeptically. "That thing has been hanging around for two days now."

"Just watch Uncle Barney; he's got it all planned," the youth boasted.

He was already connecting a hot-shot battery to the inverter normally used in the service truck to supply small amounts of 117 volt a.c. from the car battery when needed. This combination went into a knapsack on his back. The leather shoulder strap of the shop's Simpson field strength meter was adjusted so that the meter was carried in front of him. This instrument was plugged into the inverter, and a folded dipole fashioned from twin-lead and supported on a T-frame made of plaster lath was connected to the meter's 300-ohm binding posts. A pair of phones on the boy's head was plugged into the jack of the field strength meter.

He switched on the instrument, carefully manipulated its fine-tuning control, and swished the probe antenna about as he listened intently.

"Contact!" he shouted triumphantly. "I can hear it fine, and it reads thirty microvolts on the meter. Open the back door and let old bring-em-back-alive-Barney out. If you don't hear from me in a couple of days you'd better send out a search party."

"I'll not wait that long," Mac shouted back so Barney could hear him with the phones on. "Neither your legs nor that hot-shot battery will last very long with the load they are carrying."

Barney sallied forth into the alley and Mac, still chuckling at the ludicrous figure his assistant made with all the paraphernalia, went back to the bench and picked up what Barney termed "Mac's idea of a thrilling whodunit book." It was Milton Kiver's "TV Servicing Shortcuts" and really was as fascinating to Mac as any collection of detective stories; for it was not made up of just rare service problems but was composed of actual cases encountered in routine servicing of a wide variety of sets. He became so engrossed in reading about the symptoms and then trying to guess the trouble before reading ahead to see if he was right or wrong that he did not note the passage of time. When he did look up it was to see the test pattern standing perfectly still with no sign of interference. At the same time there was a lusty kicking at the back door to indicate the interference sleuth had returned.

"Mission accomplished!" Barney announced triumphantly as soon as Mac opened the door. He lumbered inside

and waved an old-fashioned shaded light globe under Mac's nose. "I just watched the meter and kept moving toward where the antenna's directional pattern and the changing meter reading pointed, and I walked right up to this relic in a socket overloading platform down the alley. When I told the store owner about it and offered to buy him a new one for this one, he said I was welcome to it for it had been fouling up a set in the store for a couple of days too. Said he couldn't imagine where the maintenance man ever found something in the first place. Anyway, it puts out a mean 5000 microvolts on Channel 6 when you put the antenna right up against it."

"Anyone comment on your appearance?" Mac asked with a grin as he helped Barney out of his rigging.

"No, but a gang of little boys gave me a hard time. They called me 'Flash' and kept wanting to hear me talk to my space ship. Finally I had to tell them that if they didn't stop I was going to melt them down with my atomic disintegrator pistol."

"Guess we've got to rack up another victory for the good old field strength meter," Mac commented as he fondly patted the gray enamel case of the instrument. "This thing has more uses than a piece of twine."

"Yet quite a few technicians try to get along without one," Barney pointed out. "They argue that all field strength meter is good for is to tell if a signal is coming down the feed line and to help point the antenna at the station when you install it. They say they can tell all that just by watching the set itself."

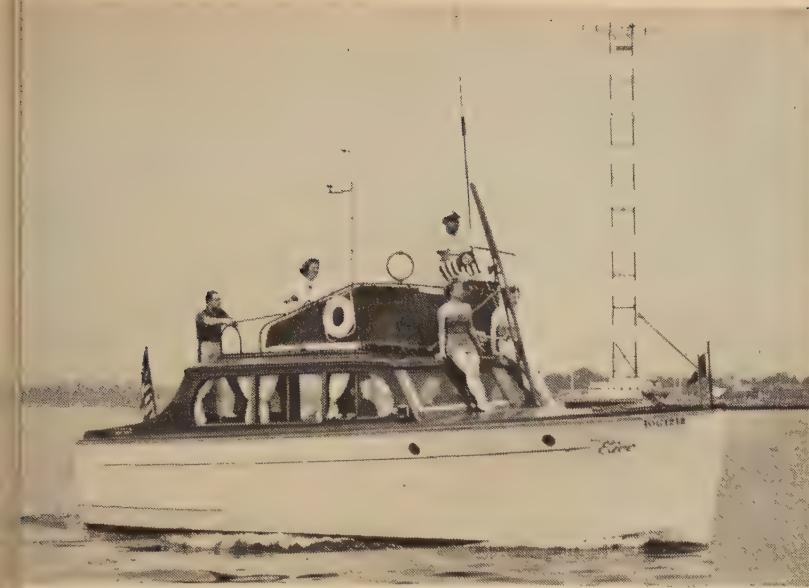
"Then they've got a better eye than I have. We found out from experience with the meter that as soon as you pass 200 microvolts of signal it takes a tremendous increase to show much effect on the picture. The a.g.c. circuit does its best to hold the signal delivered to the picture tube at the same value no matter how the signal at the antenna terminals changes. You line up an antenna with just a picture for an indicator, you get an impression the main receiving lobes much, much wider than it really is. With the meter, since it responds to the slightest change in signal strength, you can point the antenna right on the button. However, I'll not argue that signal strength meter will do a lot of jobs that cannot be done by any other means; I'm simply convinced it does these jobs quicker, easier, and more accurately."

"Know what you mean," Barney agreed. "When I run up against a set with a normal raster but with a weak picture and sound or none at all, my first move is to hook up the field strength meter to the antenna. If a good signal is coming in, I know I can concentrate on the set; if not, I know I'm in for some roof scamping. A funny thing, too, is how much that meter impresses the average customer." (Continued on page 11)

ELECTRONICS FOR THE YACHTSMAN

By HARRY R. ASHLEY

Pres., Electronic Instrument Co., Inc. (Eico)



Over-all view of the motor yacht "Miss Eico" showing radio and TV antennas and direction finder loop. Station WCBS' transmitting tower at New Rochelle, N. Y. may be seen at right rear.

to the pleasure and safety of your cruises
using modern marine electronic equipment.

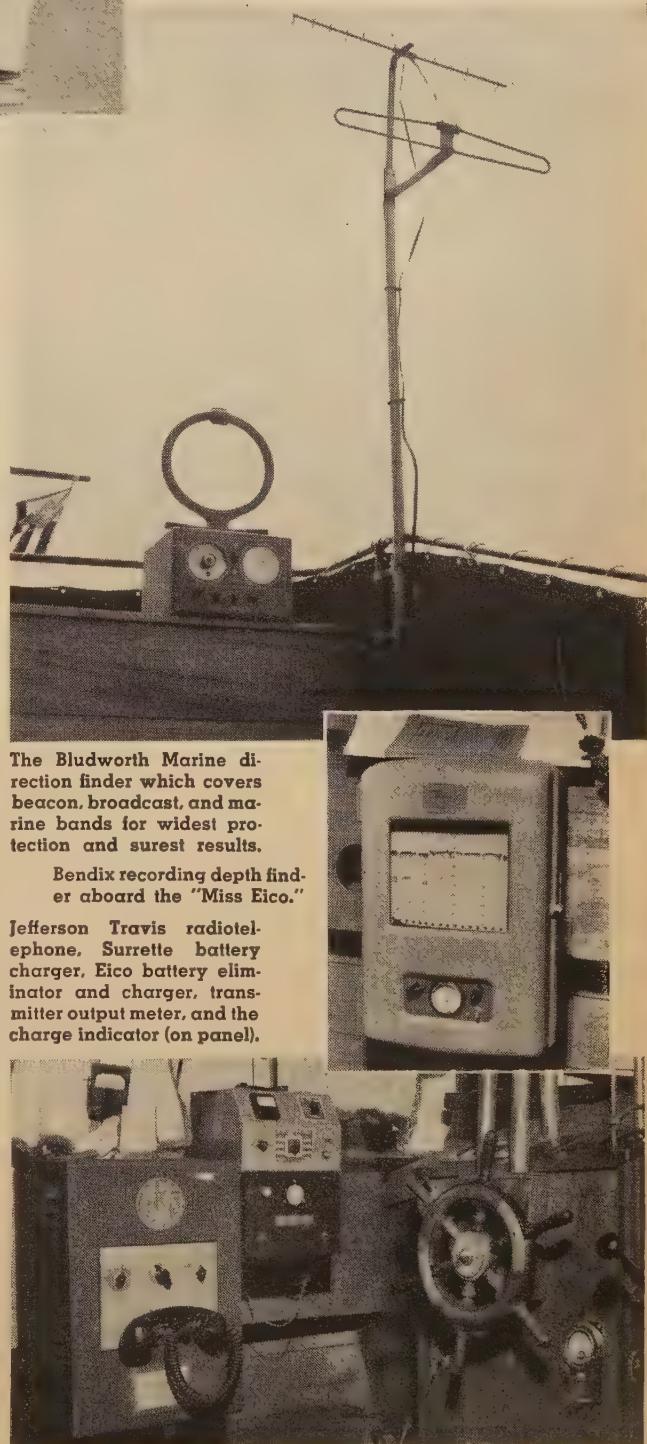
THE longing which prompted Masefield to declaim "I must go down to the sea again", has obviously gripped large segments of the American populace as literally thousands are joining the ranks of small boat owners each year. Whether the "sea" is the Atlantic Ocean, Lake Michigan, or some quiet inland lake or riverway, the lure is proving irresistible to many a weekday landlubber".

The questions foremost in the minds of the average present or prospective boat owners are what electronic equipment should I have and what will it cost? Since World War, many marine electronic items have been made available to the small boat owner through simplification, miniaturization, and price reduction. Today even the most modestly priced bottom can boast of a radio receiver capable of tuning the marine bands. From such minimal equipment the electronic gear a boat may carry will range all the way up to an elaborate installation worthy of an ocean-going liner.

Should the boat be a small one which is to be operated exclusively in charted channels or within sight of land, electronic equipment is not essential. Any gear which is installed, however, adds to the operating convenience of the craft but falls more or less into the "luxury" category. For craft operating in open waters out of sight of land, a two-way radiotelephone is virtually a "must" for safety of those aboard. Radiotelephone can be readily used from any near-shore location and, should an emergency arise, the Coast Guard can be summoned. This one equipment may be used for ship-to-ship contacts for friendly exchange of information ranging all the way from navigational tips to the latest dope on where the fish are running. Because of the shared enthusiasm for boating, many friendships have been formed as a result of such informal ship-to-ship radio contacts—reminiscent of the friendships begun on the ham bands.

If you are a good seaman, one that can navigate with confidence by compass alone, perhaps you will not require the second piece of "must" equipment for the deep-water sailor. If, however, you are dubious about your seamanship or will be navigating in totally unfamiliar waters, a radio direction finder is a handy item to have aboard. Needless to say when the fog rolls in the direction finder becomes the yachtsman's "best friend".

(Continued on page 108)





International

SHORT-WAVE

Compiled by KENNETH R. BOORD

THE Japanese Standard Frequency Station, JJJY, can be heard on 4.000 (error: 5×10^{-8}) daily 1900-0900 and on 8.000 (error: 5×10^{-8}) at 1600-0600; QSL's by card; QRA is Radio Regulatory Commission, Standard Frequency Section, Engineering and Monitoring Division, Minato-ku, Aoyama, Tokyo, Japan. (Ishikawa, Takemi, Japan)

* * *

This Month's Schedules

Albania—Radio Tirana now operates on announced 6.570, 7.853 with English 1415, French 1330, German 1400, Italian 1315, 1500. (WRH)

Anglo-Egyptian Sudan—Radio Omdurman noted near 7.655 at 1330 with call, then talk or news in Arabic, followed by Arabic music. (Pearce, England)

Angola—Luanda, 9.472A, noted with music 1505; Portuguese announcements; weak to fair. (Cox, Dela.)

Argentina—LRY1, 9.760, Buenos Aires, noted mixing with TGWA, Guatemala, around 2350. (Cox, Dela.) Strong in Tokyo around 0600. (Ishikawa) Radio El Mundo, 6.120, heard 2000-2030, fair level; all-Spanish. (Borne, Sweden) LRA, 15.345, noted with news to North America 1815, strong. (Zerosh, Pa.)

Australia—Radio Australia has been moving around in its 0700-0845 beam to Eastern North America, due to QRM; by this time may be using 11.840 or may have moved to the 31-m. band (try 9.540 or 9.615). Dexter, Iowa, notes VLA15, 15.200, very good around 2200.

Bolivia—CP38, 9.497, La Paz, noted opening 2030 at good level. (Ferguson, N. C.) Heard opening 1756 with "Onward, Christian Soldiers." (Pearce, England)

Borneo (USI)—The Home Service of Radio Republic Indonesia is heard on 5.030 from Bandjermasin, with 1 kw., until 1030 closedown. (Japanese Short-Wave Club)

Brazil—Radio Relogio Federal, 4.905, Rio de Janeiro, noted 1730 re-laying "A Voz do Brasil." (de Mesquita e Sousa, Portugal) ZYK2, 15.145, Recife, noted in Sweden 0930-1010 with QRK4 signal. (Borne) Radio Tamoio, ZYC8, 9.610, good level 1915-1930. (Oestreich, Wash. State)

British Honduras—Radio Belize, 4.950, noted with news 1800; identifying 2130, followed by commercials, then light music; has trouble with Radio Dakar, Fr. West Africa, prior to 1800. (Cox, Dela.)

British New Guinea—VLT6, 6.130, now used exclusively by Port Moresby, noted 0600 with ABC news relay. (Ferguson, N. C., others)

Bulgaria—Radio Sofia, 9.700, lately has had English 1800-1815. (Zerosh, Pa., others) Now has news for Europe 1500 and 1615 on 6.070, 7.671A. (Pearce, England)

Cape Verde Islands—Praia, 5.890A, noted daily 1530-1700. (de Mesquita e Sousa, Portugal)

Ceylon—Commercial Service, 15.120, noted opening 2030; BBC news relay 2100. (Ferguson, N. C., others) Good on 11.975 at 0830. (Riggs, Calif.) Noted parallel on 9.520 at 1000-1230 close-down. (Gay, Calif.)

Chile—CE766, Radio Yungay, Santiago, noted on 7.660 fair level 1550 with music. (Cox, Dela.) Schedule is 0630-0130. (WRH) Radio Sociedad Nacional de Minería has been varying lately around 11.945-11.957; noted to around 2200. (Stark, Texas) Schedule is 0630-2300 and outlets are listed CE622, 6.220, 5 kw., and CE1198, 11.985, 2.5 kw. (WRH)

Colombia—A new station of Radio Cadena Nacional has been heard on announced 4.935 signing off between 2230-2300; HJFV, Radio Neiva, 4.855, is now on the air until 2300 weekdays, to after 0100 Sun. (Radio Sweden) HJFK, 6.098, Pereira, fair level 2010; slight QRM. (Norman, N. C.)

Costa Rica—TIHV, San Jose, is a new station heard on 6.008A; announces "Radio Cristal;" strong after 2230 when is in clear; suffers QRM earlier from HJCH, 6.009, and CJCX, Rome, and YSS on 6.010. (Robbins, Ind.)

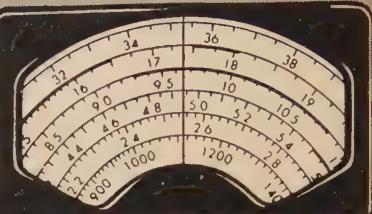
Cuba—COQ, Havana, is now using 9.675 on an irregular schedule (moved from 8.825). (Robbins, Ind.)

Cyprus—Sharq-al-Adna sent schedule of 2225-0130 daily, 0130-0330 Fri. and Sun., 0330-1500 daily on 635 kc., 6.110, 6.170, 6.790, 9.650, 11.720. (Scheiner, N. J.)

Czechoslovakia—Prague, 9.95, heard with English to North America 2300-2330A. (Hyson, Md., others)

Denmark—OZF, 9.52, Copenhagen, noted with improved signal in North

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.



American beams 2030-2130, 2200-2300 (Jim Smith, Mich.; Saylor, Va., others)

Dominican Republic—HI2A, San Pedro de los Caballeros, has moved from 9.680 to 4.840; signal peaks in 1800 around 2000, then fades to a low level and mixes badly with YVO, Venezuela, same channel. (Robbins, Ind.)

Dutch New Guinea—Radio Nederlandsch Nieuw-Guinea soon is to be returned to Beli from Hollandia; will have a new studio, a 5 kw. transmitter. (NNR, others)

Ecuador—Summer schedule HCJB, Quito, includes English to North America 2100-2400, 9.745, 11.915, 15.115, and 2300-2400 also on 6.115. English to North and South America 0630-0730 on 9.745, 11.915; English to Europe 1600-1700, 17.89, 15.115, 11.915, and 1700-1730, 17.89, 15.115; English to Pacific 0130-0500 on 15.115, 11.915, 9.745; off the air Mon. (Mathews, Ohio)

Egypt—Current schedule of CA 11.815, is 1320-1600 (Sat., Sun., 1700); news 1330. (Bellington, N. C., others) Noted on 9.750 lately as early as 1035 with call in Arabic. (Pearce, England) Heard on this channel 2100 with Arabic Service in news and Western music. (Sanderson, Australia, and others.)

Ethiopia—Radio Addis Ababa, 040A, noted 1330 in English. (McGraw, N. Y.)

Fiji—Some months ago, the Post and Telegraphs Department experimented on 6.100 parallel with regular 5.995 at Suva; latter has ABC news relay 0400; operates around 0030-0500. (Cushen, N. Z., others) More recently has tested on 3.980. (Radio Australia)

Finland—Helsinki, 15.19, noted English around 1430-1440. (Goldberg, Mass., others)

France—Paris noted opening 15.24 on French on 15.24 at 0730, excellent level. (Golden, Mass.) Heard para on 9.55, 6.200 at 1745 tune-in via Paris-Inter session in French. (Bellington, N. Y.) The English Service to Great Britain now is daily 0145, 7.240, French Lesson; daily 1345, 11.970, French Lesson; daily 1500-1530 on 6.050 with varied programs; answers to listeners' letters Wed., Sat. (Catch, England) Noted in France 1830-2000 on 9.680, 11.700. (Dexter, Iowa)

French Equatorial Africa—Brazzaville, 9.44, 11.970, noted with news (Continued on page 86)

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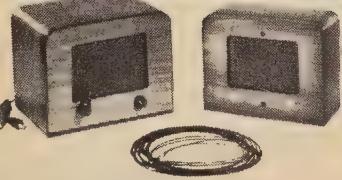
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1P3	.54	6A8	.52	6SL7	.52	12AU7	.56	35L6	.48
1R5	.56	6BA6	.45	6V7	.54	12AV6	.52	35Z6	.33
1S5	.48	6BC5	.58	6SN7	.42	12AX7	.60	50B5	.48
1U4	.48	6BC7	.86	6SQ7	.42	12AU8	.94	50C5	.47
1U5	.48	6BE6	.48	6SR7	.42	12AV8	.46	50L6	.48
1U6	.53	6BG6	.18	6T6	.74	12AS6	.59	80	.36
3V4	.48	6BH6	.62	6US	.57	12BA7	.46	11723	.36
SU4	.47	6BJ6	.53	6UB	.78	12BE6	.46		
SW4	.46	6BN6	.74	6VGGT	.46	12SA7	.52		
6A7	.62	6CA4	.34	6V8	.83	12SK7	.49		
6A8	.51	6CB6	.48	6W4	.45	12SL7	.57		
6AG5	.62	6CD6	1.2	6W6	.52	12SQ7	.54		
6AK5	1.1	6DF6	.49	6X6	.37	14AF7	.59		
6AU5	.41	6E6	.79	7C6	.42	14N7	.64		
6AV6	.43	6J6	.41	7N7	.52	19T8	.78		
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Reproduced and distributed by t-
RCA Victor Division of Radio Corp-
ration of America. 1423 pages. Pri-
\$7.00. Fourth Edition.

Those who are familiar with the earlier editions of this handbook will be both surprised and pleased by the encyclopedic proportions it has assumed in this newest and most complete version.

This well-known "bible" of the industry is four times larger than the Third Edition published in 1940, reflecting the great strides made by the electronics industry in the past decade or so.

The text material is prepared with the engineer, student, and experimenter in mind and covers thorough the design of radio and audio circuits and equipment. The information on circuit design and application is presented not only mathematically but practically so that those with limited engineering experience can profit from the exposition. For the engineer who wants to know "why" and "how" such circuits function—that information is also provided.

The book itself is divided into seven major sections and covers such topics as radio tubes; general theory and components; audio frequencies; radio frequencies; rectification, regulation, filtering, and hum; complete receivers and an impressive array of tables, graphs, charts, bibliographies, references, etc.

For a compact and ready-referent source of a veritable gold mine of pertinent information, this book will be hard to beat.

* * *

"TV MANUFACTURERS' RECEIVING TROUBLE CURES" edited by Milton Snitzer, Published by John F. Rider Publisher, Inc., New York. 113 pages. Price \$1.80. Paper bound. Volume

This is the third in the current Rider series covering troubleshooting procedures as developed by the manufacturers themselves.

Service notes for receivers manufactured by Kaye-Halbert, Kent, Mavox, Majestic, Meek, Mercury, Midwest, Montgomery Ward, Motor-Muntz, National, North American, Philips, Olympic, Pacific Mercury, Packard-Bell, and Philco have been included in this volume.

The book is completely indexed by model numbers to permit the rapid location of the desired data. Subsequent volumes will cover receivers other companies.

* * *

"TV SWEEP ALIGNMENT TECHNIQUES" by Art Liebscher. Published by John F. Rider Publisher, Inc., New York. 120 pages. Price \$2.10. Paper bound.



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This is a practical handbook for the television technician which is characterized by the common-sense approach which marks all of Mr. Liebscher's writings.

The book is divided into eleven main chapters and includes discussions of modern sweep alignment, sweep alignment techniques, markers, "supermark," sweep curves, tuner curve formation, i.f. alignment, i.f. curve adjustment, sound i.f. and sound detector alignment, video amplifier response testing, and u.h.f. sweep alignment.

The text material is lavishly illustrated with oscilloscope patterns showing the various circuit conditions encountered in television service work.

Both the practicing service technician and the student will find this little book a worthwhile adjunct to the servicing library.

* * *

**"UHF ANTENNAS, CONVERTERS,
AND TUNERS"** by Milton S. Kiver,
Published by Howard W. Sams & Co.,
Inc., Indianapolis, Ind. 134 pages.
Price \$1.50. Paper bound.

As more and more television stations take to the air in the u.h.f. band, more and more service technicians are encountering problems heretofore unheard of in their experience.

To cope with these new and unfamiliar problems, Mr. Kiver has written this down-to-earth book to answer just such questions. The book is divided into five sections and deals in detail with such subjects as u.h.f. antennas, transmission lines and match-

ing networks, u.h.f. installation tactics, u.h.f. converters, and tuners.

The material presented is specific and to the point. Similarities and differences between v.h.f. and u.h.f. systems are pointed out where comparisons serve to advance understanding of circuit operation. Photographs, drawings, graphs, sketches have been used lavishly to amplify the text material.

Mr. Kiver's style is familiar to readers of this magazine so it comes as no surprise to them to learn that this book is in the same clear-cut form as his articles, which should provide the technician with a lot of much-needed and authentic data on u.h.f.

-30-

AMATEUR EXTRA CLASS

FCC has announced that radio "timers" applying for the Extra Class amateur radio license may submit a waiver of some of the requirements of the "Certificate of Skill" issued by the Department of Commerce and Labor before June 30, 1913. Heretofore it has been necessary for an applicant to submit a waiver to show evidence of possession of an actual amateur license before April, 1917. It is necessary, when applying for an "Extra Class" license, to supply evidence of ownership or operation of an actual amateur station before June 30, 1913. Details are in the Commission's Safety Special Radio Services Bureau Bulletin No. 2, available from FCC, Washington 25, D. C.

-30-

Stromberg-Carlson Company's Sound Division at Rochester, N. Y. has placed in operation a new 2½ ton magnetizing unit on its loudspeaker assembly line. The new electric magnet was designed especially for magnetizing the 10½ pound piece of Alnico V that serves as the permanent magnet in the company's 15 inch high-fidelity speakers. The magnetizing unit consists of a steel yoke, supporting the two pole pieces, each one foot in diameter. Each of the pole pieces is wound with three coils. There are approximately 700 pounds of copper in the coils. The complete assembly weighs slightly over 5000 pounds. The photoelectric cell which controls the magnetizer is activated by the loudspeaker passing through the light beam on the slowly moving belt.



Six-Meter Transceiver

(Continued from page 58)

3½" over-all, which contributes much to a neat finished appearance. The transceiver is built as two small assemblies which are completely wired before mounting within the "Minibox." Aluminum sheet salvaged from old transcriptions was folded to form the two chassis bases. A flat mounting plate with lips serves for the receiver and audio section, with the tubes and audio transformers mounted below the plate. The transmitter r.f. section required a stepped chassis to position the tubes and coil forms properly. The layout of components for these two units has to be carefully correlated so that the sections will interlace when fitted to the "Minibox."

The control switches should be mounted on the "Minibox" panel with suitable lengths of wire soldered to them before the two subassemblies are bolted in place in one corner of the box. The interconnecting wiring can then be completed, and the end support plate attached to form the battery compartment. This space measures just under 4" x 6" to provide room for two 90-volt "B" batteries in parallel, together with three 1½-volt flashlight cells which are connected in parallel for the "A" supply.

Operation and Adjustment

The initial tune-up of the transmitter is most easily done with the aid of a grid-dip meter. The oscillator

(A) Details of the transmitter chassis, bent up from sheet aluminum. (B) A dummy load for tuning the transmitter. (C) Details of the receiver coil mounting bracket. Its position can be seen in receiver bottom-view photograph. Receiver chassis is a flat mounting plate, 3½" x 6", with ¾" lips. See photos for parts layout.

slug should be detuned slightly from resonance so that the circuit will be sure to oscillate whenever power is applied. The multiplier tanks are tuned for peak output. The "Minibox" cover has some detuning effect on the coils, so optimum adjustments are best made with this cover in place. Small ¼" holes drilled in the cover to give access to the slugs from outside can be neatly covered by hole plugs when not in use.

A communications receiver "S" meter, or a voltmeter connected to the suggested dummy load will make a handy output indicator for the tuning adjustments.

The detector slug, accessible through the front panel hole, can be adjusted by listening to a received signal. Since the operation is on a fixed frequency, the tuning adjustment will hold for long periods.

As would be expected, the useful range of the transceiver is limited by the signal-to-noise ratio of the receiver, so antenna efficiency plays a major part in the performance. Center- and top-loaded verticals were found to be less satisfactory than a quarter-wave whip for portable operation. A three-section collapsible auto radio whip fitted to a coax connector has proved to be a very serviceable antenna.

Any simulated ground plane or counterpoise will increase the antenna effectiveness. The range can, therefore, be increased by placing the transceiver on top of a car or other metal surface. In some applications a low-channel TV antenna can be used with excellent results. When used in a car, the regular 55" broad-

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—Canadian Industrial Equipment News

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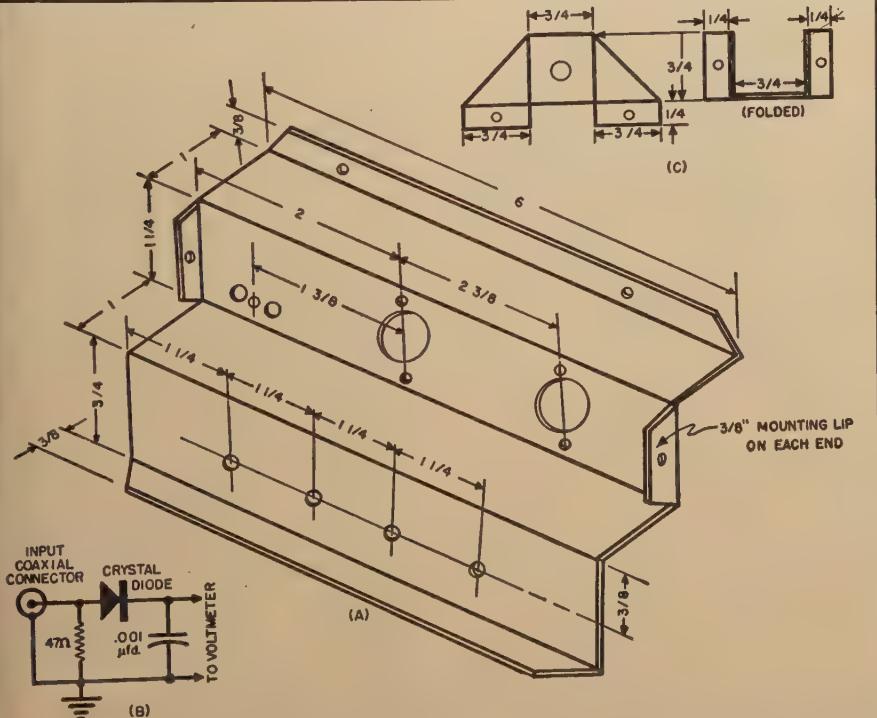
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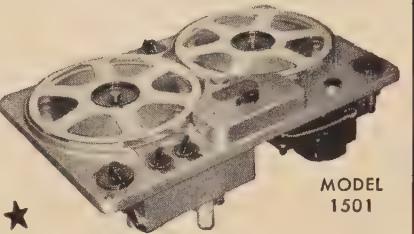
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5000 v. range on both AC and DC?	YES	Yes	No	Yes	No
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The range between transceivers is naturally affected by intervening terrain. Transmissions of a mile or so can be expected over good paths when the units are hand-held, with correspondingly greater coverage when better antenna systems are used. —30

Anti-Flutter Circuit

(Continued from page 39)

a diode a.g.c. circuit, direct-coupled video amplifier, and cathode drive to the picture tube. Its modification is more complicated. See Fig. 4. The 470k resistor and parallel condenser are removed and replaced by the anti-flutter network shown in Fig. 4B. The resistance values in the network are modified as one of the steps to restore the picture tube cathode potential to its original value and the condensers are changed to maintain the proper time constants with the new resistance values. A resistance-capacitance low-frequency compensation network is added in the plate circuit as the second step in restoring the picture tube cathode potential and also to boost the transmission of the video signal d.c. component to approximately 100%, assuming a picture tube cathode input resistance of 50,000 ohms.

REFERENCES

1. Billin, J. J.: "Anti-Flutter Circuit," *Journal of the Television Society*, October 1952.
2. British Patent 648,537.

INTERNATIONAL CONTACTS

UNITED STATES radio amateurs are reminded that communication between amateur stations licensed by the Federal Communications Commission and foreign amateur stations is permissible subject to the limitations of Section 1 of Article 42 of the Radio Regulation annexed to the International Telecommunications Convention (Atlantic City 1947). Section 1 of this Article provides as follows:

"Radiocommunications between amateur stations of different countries shall be forbidden if the Administration of one of the countries concerned has not filed that it objects to such radiocommunications."

Information available through April 16, 1953, indicates that the following countries have forbidden radio communication between their amateur stations and amateur stations of other countries: Austria, Cambodia, Indonesia, Iran (an amateur operation forbidden), Korea, Laos, Thailand, and Viet Nam.

Amateur stations in Australia are authorized to conduct radiocommunication for purely experimental purposes with amateur stations in other countries, the administrations of which permit such radiocommunication.

Amateur service has not yet been organized in Jordan and Rumania.

This information does not modify the handling of third-party communications by amateurs as outlined in the Commission's Public Notice of April 1952.

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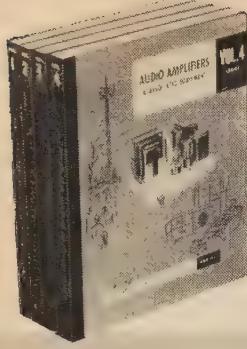
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MANY FM-AM enthusiasts purchased sets as soon as they were available after World War II. Although many have given excellent service through the years, almost all of them are performing considerably below what could be expected of them.

The modernization of a *Meissner* Model 2961 is described. Some, or all, of the changes described can be applied profitably to most FM-AM receivers.

The *Meissner* Model 2961 is a 29 tube FM-AM-phono combination with completely independent FM and AM tuners, but a common power supply and audio system. It was equipped with a phono unit having a crystal pickup and compensating preamplifier.

The audio system uses four 6L6 tubes, triode connected, in push-pull parallel as output tubes. Original specifications called for substantially flat response between 60 and 20,000 cps. Since the speaker with which this unit is equipped is capable of good reproduction of considerably lower frequencies, all audio coupling condensers in the main audio unit were replaced with .1 μ fd., 600 volt units. Low frequency response was considerably improved by this change.

To obtain better record reproduction, the crystal pickup was replaced with a *G-E* reluctance unit. This necessitated replacement of the original preamp stage using a 9002 triode, with a 6SC7 preamp stage. The 6SC7 tube was mounted in the same position as the original preamplifier by removing the miniature socket, reaming the hole, and mounting an octal socket. See diagram Fig. 1.

In the FM unit, the 6AG5 r.f. tube and the three 6AG5 i.f. tubes are replaced by 6CB6 tubes, a newer, hotter

Rear view of the author's "modernized" FM tuner. At the extreme left is the Drake 300-ohm hi-pass filter. The glass tube above the "UL" stamp on the chassis is the 6SC7 preamplifier with aluminum foil wrapped around it. This is not necessary if a metal tube is used. To the rear of the 6SC7 and above it is the 6AB4 grounded-grid r.f. stage mounted on aluminum bracket. Behind this is the original FM tuner. To the right of the tuner is the AM r.f. mixer and oscillator tubes. In front of the AM tuning condenser is the new "Ferri-Loop" antenna. The 300-ohm ribbon to this antenna connects one side of the original loop antenna to top of "Ferri-Loop." The two hook-up wires from top of cabinet are built-in antennas, one for push-button tuner and the other for reception on the shortwave bands.

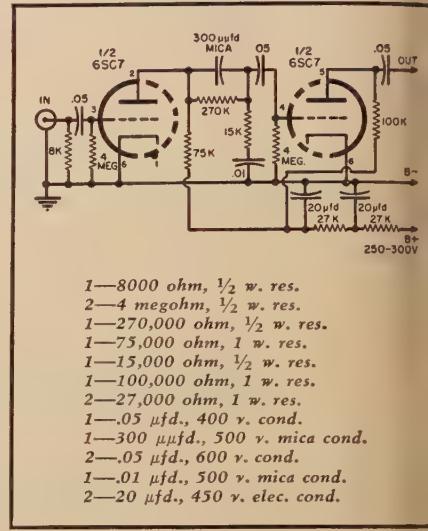
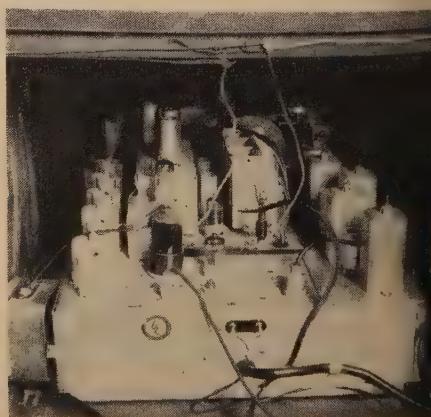


Fig. 1. Preamp circuit added to permit use of the G-E variable reluctance pickup unit.

type. No circuit changes are required except to connect pins 2 and 7 together at each tube socket concerned.

Re-alignment of the set will be required. While the use of a sweep generator and oscilloscope is preferred, a thoroughly satisfactory job can be done with nothing more than a good FM station within comparatively short range.

Tune the set to the high frequency portion of the FM band to a point where no station is being received. Beginning with the i.f. transformer nearest the discriminator (not the discriminator transformer), and progressing toward the "front end", adjust all i.f. transformers for maximum noise output. (Better relations with the wife and other members of the family will be maintained if this is done when you



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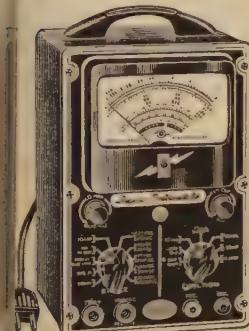
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- D.C. CURRENT: 0 to 1.5/15/150 MA. 0 to 1.5/15/150 Amperes.
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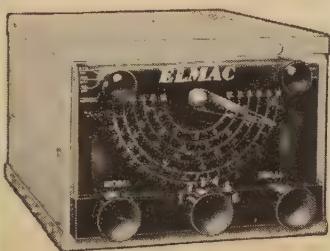
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HINTS and KINKS for MOBILEERS

By JACK NAJORK, W2HNN

These simple antenna tricks and a painless addition to the receiver will add greatly to the enjoyment of mobile QSO's.

MANY articles on center- and base-loaded mobile antennas have pointed out that an antenna of this type must be accurately pruned to resonance at the operating frequency if it is to accept power and do a good job of radiating. If the ham is fortunate enough to own a grid-dip meter, finding the resonant frequency of the antenna is a simple matter.

Without such an instrument, determination of antenna frequency can become quite a problem, especially if a loading coil of unknown inductance is used with a whip whose capacity is also a matter of speculation. Starting with such a combination, it is often found that the resonant frequency of the system may be a half megacycle or more removed from the desired frequency.

The approximate resonant frequency of a new or experimental antenna of this type can be found very easily (and inexpensively) by a method filched from the broadcast antenna engineers*, which makes use of an ordinary buzzer and a calibrated receiver. The whip is grounded and the buzzer is loosely coupled to it, as shown in Fig. 1A. The resulting shock excitation of the system radiates a signal which peaks up sharply at the resonant frequency of the antenna. The station receiver is used to find this frequency and the system can then be pruned to the desired channel.

This method really works very well, the buzzer radiation showing a peak about 30 kc. wide which can be detected at a distance of twenty to thirty feet from the antenna with the average communications receiver. The higher the "Q" of the antenna being excited, the sharper will be the noise peak.

It is best to make the test at a

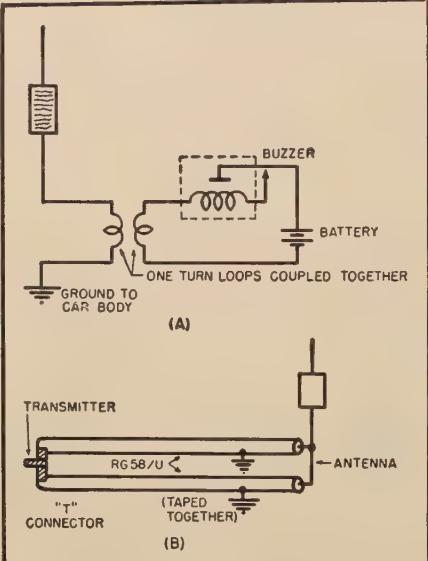


Fig. 1. (A) Method of using a buzzer to determine resonant frequency of a mobile antenna. (B) The use of paralleled 52-ohm coax cables to improve impedance match.

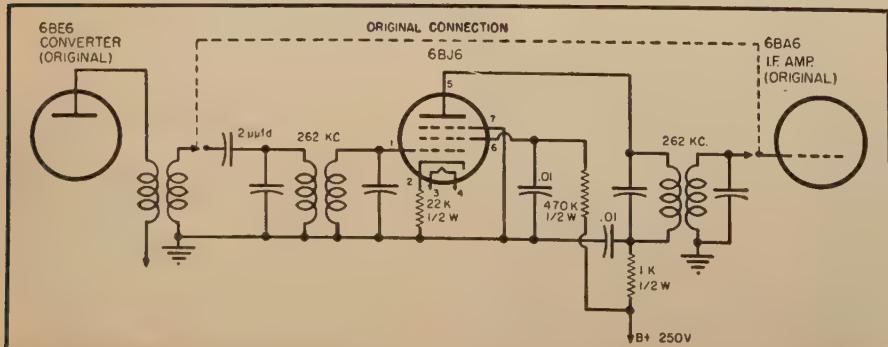
time when the frequencies involved are relatively quiet, otherwise strong QRM may mask the noise peak. To prevent detuning, short leads should be used at the base of the antenna. An extra two inches in the form of a single-turn loop will provide sufficient coupling.

Feeding the Loaded Whip

Antennoscope measurements on a number of base- and centerloaded 75 meter whips show that the base impedance of these systems is very close to 25 ohms. Although 52-ohm coax can be used as a feed line, a much

* Henney, Keith: "Radio Engineering Handbook" (4th Rev. Ed.), chap. 14, p. 613.

Fig. 2. Circuit diagram of an additional i.f. stage for the car's broadcast receiver to improve over-all selectivity. Unmarked condensers are in the i.f. cans.



better match can be obtained by using two sections of small diameter RG58/U (53.5 ohms) in parallel.

A neat job can be done by taping the two sections of line together and using a "T" coax fitting at the transmitter end, as shown in Fig. 1B.

Improving Receiver Selectivity

The usual converter-car receiver combination used for mobile reception leaves much to be desired from the standpoint of selectivity, especially on the lower frequency bands where considerable activity is encountered. Aside from the common deficiency of poor station separation, the poor selectivity causes loss of gain on weaker signals, because a.v.c. action on a strong adjacent carrier decreases the sensitivity of the receiver over a relatively broad spectrum. Since adjacent-channel attenuation is primarily a function of the i.f. bandwidth of the car receiver, considerable improvement can be made by sharpening the skirt selectivity in the i.f. amplifier in "Q-5'er" fashion by the insertion of additional tuned circuits.

Such a modification is not nearly as complicated as it sounds or looks, and it will be found that quite a few of the modern automobile receivers now have ample room for the additional components required.

Fig. 2 shows the circuit added to a 1950 Philco receiver in the author's Studebaker. Two additional midget i.f. cans (four tuned circuits) were added between the mixer and i.f. amplifier tubes, together with a 6BJ6 amplifier tube. There was sufficient room inside the set to mount these components alongside the i.f. amplifier stage without crowding.

With the circuit values shown (26 kc. i.f.) the gain of the 6BJ6 stage is held down to 1.5 times because all that is desired here is sufficient amplification to make up for the insertion loss of the additional transformers. It is necessary that the suppressor of the 6BJ6 be grounded rather than being connected in usual fashion to the cathode. With the high value of cathode resistance used, the tube cut off completely until this change was made. Total cathode current of the 6BJ6 is less than two milliamperes, and the heater current was gotten "for free" by disconnecting one of the two dial lamps.

You will have to take the usual precautions in installing the extra stage to avoid oscillation in the i.f. system of the set.

After the modification is made, complete i.f. alignment (preferably visual alignment with a sweep generator and scope) should be carried out. When you put the set back in operation you will find that you can sneak up a lot closer to the strong ones to copy those "S3" signals that were formerly "snowed under." This additional stage gives a healthy improvement with practically no increase in power consumption.

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2-Mike Pre-Amp \$12.95 Extra. Not Kit, but a Manufactured Amp.

50-WATT BOOSTER

A sensible 50 watt booster amplifier with push-pull parallel 5L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input matches 30 watts of audio. Booster has a 12" speaker with 100 ohm voice coil, plus a 225 mill power supply with 5U4 rectifier. Price includes tubes: 8 6L6, 7N7 and GU4. The two variable controls are for master volume control and bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55N. Shipping weight 26 lbs. Sale price \$39.95 ea.

2-MIKE PRE-AMP. It enables use of 2 microphones plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 50 watt Booster Amplifier. Small chassis size 5 x 3½ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price \$12.95 ea.

McGEE'S \$62.50 LIST 15" COAXIAL SPEAKER, \$23.95

New 1953 Model—21 Oz. Alnico V Magnet—5" Tweeter

This is the finest 15" coaxial FM speaker value that we have ever offered. New 1953 production, of a famous manufacturer of fine speakers. The 15" speaker has a 2½ oz. Alnico V magnet; equal to 68 oz. of magnetic pole area. The 5" tweeter has a 1½ oz. magnet. The two variable controls are for master volume control and bass boost tone control. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is located under the pot cover, leaving only two wires to connect to both the tweeter and the 15" speaker. 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P-15CS, shipping weight 13 lbs. Net price \$23.95.

12" JENSEN PM, \$15.95

Another McGee Scoop! Jensen Concert 12", 1½ oz. Alnico V magnet PM speaker. 8 inch voice coil. Will take 25 watts audio. You save dollars on the speaker. Just \$100.00 each. Shipping weight 8 lbs. Stock No. P-12P. Sale price \$15.95; 2 for \$30.00.

12" COAXIAL SPEAKER, \$12.95

McGee offers the new 1953 model 12" coaxial FM speaker. Quality you would put in your finest sets if you were a manufacturer. 12" woofer has 8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under the 12" woofer. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 watts average power. Shipping weight 8 lbs. Stock No. CU-14Y, Sale price \$12.95 each; 2 for \$25.00.

G.I. 3-SPEED CHANGER WITH G.E. \$22.95

VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE

Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changer. Complete with RPX-050 G.E. variable reluctance cartridge with turn-about status. Plays all 3 speeds automatically. Base size, 12" x 12" x 2¾". Repeats last record. Stock No. 700-GE. Scoop price, \$22.95.

GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700. Sale price, \$21.95 each.

10-TUBE RADIO KIT \$29.95

10-tube broadcast pre-amp radio kit, complete with tubes: 2-6SK7, 5-6SN7, 1-6SL7, 2-6V6.

plus 1-6V3 rectifier, dia-gram and instructions. 3 gang superhet with 8" slide plate. Chassis size, 12½" x 10" x 6½".

Features push-pull, 6V6 high fidelity audio. Output matches 8 ohm voice coil speaker. Inputs for G.E. variable reluctance cartridge and crystal phone pickup and crystal mike. Heavy duty power transformer. Model BK-R10 kit less speaker, shipping weight 18 lbs. Net \$29.95.

17, 20" T.V. KIT \$59.95 Less Tubes

A complete kit of parts to build an AC transformer operated television chassis for use with 16", 17" or 20" rectangular picture tube. The 12 channel tuner is ready wired, as is the 4 tube video IF strip.

Complete in one conventional design. Do not buy this unless you understand television. It is difficult to wire. We furnish schematic. Kit model WH-20. Shipping weight 18 lbs. less all tubes. Net \$59.95. Cascade tuner \$10.00 extra!

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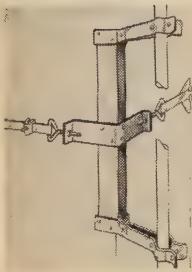
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South River NEWS



CHIMNEY UNI-MOUNT Model UM-1
Riveted, heavy-gauge, galv. steel with wide, flared-lip, snap-in mast holders. 18" spacing between mast holders for firm support.

between mast holders for firm support. Available with one heavy-gauge stainless steel strap, Kwik-Klip banding closure and Chimney Corner Guards.
Model UM-2 . . . same as UM-1 with 2 heavy-gauge stainless steel straps.

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PIONEER AND OUTSTANDING PRODUCER OF FINEST LINE OF ANTENNA MOUNTS

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Electrical Weather-Stripping by Eimac — Now Available!

Silver-plated, spring alloy, pre-formed finger stock especially suited for electrical "weather-stripping" for TVI-proofing cabinet access doors, etc. Also ideal for making coaxially constructed tube connections and many other uses. Available in 17/32", 31/32", and 1 1/8" widths.

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**REGULAR LIST \$82.50,
DESIGN BY DR. OLSON!**

BIGGEST BUY IN A QUALITY 15" COAX WE'VE EVER SEEN!
40-12,000 cps., 25 watts, 2 lb. magnet, 16 ohms,
x-over 2000 cycles, duo-cone. Order No. R-510BRN.
Ship. wt. 16 lbs.

\$29.50

CLOCK-TIMER 29% OFF!

Famous-make \$5.50 switch-timer clock, all knobs on front. Turns radios etc. on up to 12 hrs., tells time. New! Complete! Order No. R-5105RN Ship. 1 1/2 lbs.

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3-SPEED NEEDLE, \$4.98!**

FITS ANY thumb-screw or set-screw cartridge! Guaranteed! Order No. R-5097RN.

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Just a few left! Stancor ST-203-A mobile transmitter kits, reg. \$47.50 net less tubes. Sale price \$36.50, Order No. R-5107RN. Hurry! Wt. 10 lbs. Kit of 5 tubes: order no. R-5096RN, only \$6.15.



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Also makes hot R9er-type pre-selector on 2 meters! Built-in AC supply. Continuous 52-216 mc range! New, guar. model BT-1. Order No. 36-601RN. Wt. 5 lbs. Limited quantity!



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RADIO SHACK

CORPORATION

167 Washington St., Boston 8, Mass.

International Short-Wave

(Continued from page 68)

1745-1800 closing. (Roberts, Conn others) Good with news on the channels. (MacIndoe, N. J.)

Germany—Overseas Service from Cologne noted on 11.795 at 1400 to Africa; signed off with German, English announcements 1547. (Pearce, England) Heard on 6.270 at 0045 to North Africa. (Sanderson) Surprisingly good signal heard on 7.290 around 2130; news in German 0015-0025. (Lerch, Mass.) Has Mailbag Program Mon. 1400, 1800 on 11.795; 2130 on 6.270, 7.290; Tue. 0630 on 15.275, 1030 on 11.795. Correct reports will be verified by new card. The "Staatliche Rundfunkkomitee" in the Russian Zone operates Berlin I, 6.115, at 2330-1930 Berlin II, 7.150, at 2230-1930, and Berlin III, 9.730, at 2230-1900. (Radio Sweden) AFN, 5.740, Beyreuth, note in Sweden 1200 with jazz music (Malmo DX-aren, Sweden)

Gold Coast—ZOY, 4.915, Accra shortly will increase power to 20 kw (Fox, N. Z., via Radio Australia)

Greece—Radio Athens, 11.718, note around 1240 in English. (Mast, N. Y. others) Central Forces Radio Station 6.33, Athens, seems nearer 6.34 lately noted 1330 with call in Greek, the Greek music; also heard 0100 with Greek songs. Larissa, 6.745, note 0115 with popular music. (Pearce, England)

Guadeloupe—FG8HA, 9.430V, Bass Terre noted 1810 in French; closed 2000 with "La Marseillaise." (Cox, Dela.) Heard also erratically 0600-0630 closedown. (Stark, Texas, others)

Guam—KUJ39, 9.490, noted testing irregularly around 0250. (Hooker, Alberta)

Guatemala—TGWA noted opening 0730 on 9.760 (rather than old 15.1 outlet.) (Ferguson, N. C.) If not found on 9.760, try 15.17.

TGCQ, 9.702, noted around 2315 at weak level. (Cox, Dela., Stark, Texas) TGNA lists frequencies of 720 kc 5.9525, 9.668, 11.850, 15.100 (*inactive*) 17.870 (*inactive*). (Carroll, Me.)

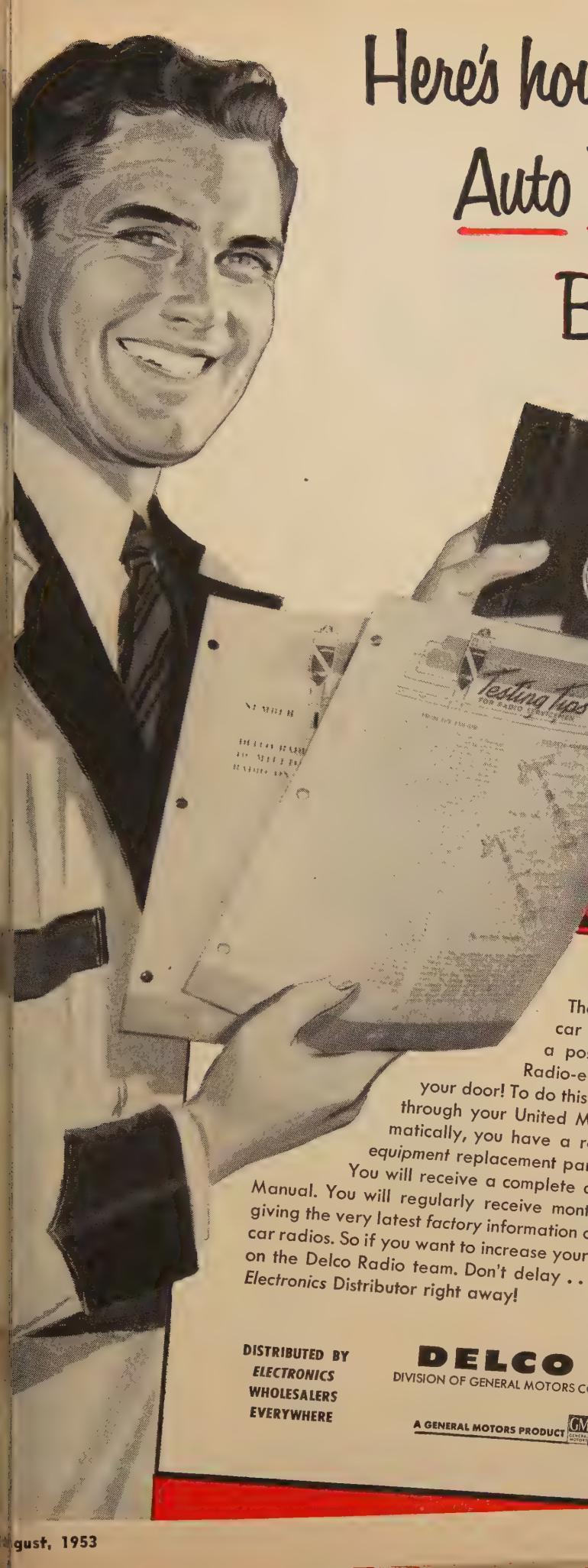
Haiti—4VEH, Cap Haitien, note 0600-0900 on 9.69A, mostly English (Middleton, Ohio) 4VCP, Cap Haitien is now back on 6.993, modulation still poor. (Robbins, Ind.) Radio Haiti noted recently parallel on 10.06A, 5.8 with English in progress at 2146 tuning; continued with U. S. popular music until 2221 closedown. (Gay, California)

Holland—Hilversum, 11.730, note with music 1700-1725, then short newscast prior to 1730 closedown (Wade, Fla.)

Honduras—HRP1, San Pedro Sul has moved from 6.351 to 6.360 where it mixes badly with Lisbon around 1800. (Robbins, Ind.)

Hungary—Budapest, 11.910, note in English 1800-1815. (Zerosh, Pa.)

Iceland—TFJ, 12.175, noted Sunday only in its 1115-1130 session in Icelandic; CWQRM, QSB. (Cox, Dela.)



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There's one sure way to get ahead in the car radio repair business, and that's to be in a position to tap the vast market of Delco Radio-equipped cars and trucks that daily passes

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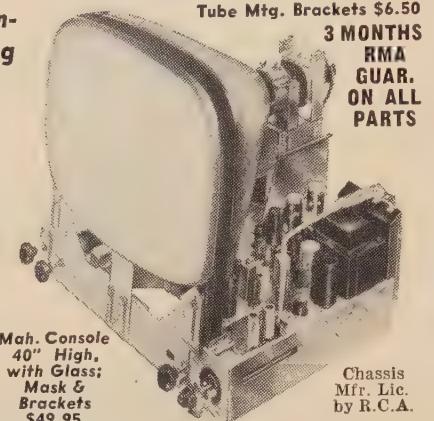
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THE ONLY CHASSIS WITH
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Complete with 12" ROLA Hi-Fi Speaker
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New, Sensitive
FLUTTER METER

First Aid for the sound engineer — the ACA Flutter Meter! Accurate, sensitive instrument designed for rapid visual indication of flutter, wow, and drift content of discs (all speeds), sound film mechanisms, film recorders, and magnetic wire and tape recorders.

Three distinct and simultaneous readings may be made of flutter, wow, and drift. Large, sensitive 4" meter has three scales: 0.3%, 1.0%, and 3.0%, calibrated for flutter, wow, and drift readings. Accuracy within 2% of full scale value, independent of wave-form, amplitude variation, hum, noise, etc.

Flutter Meter complies with tentative standards set by Society of Motion Picture Engineers. Recommended for schools, labs, broadcast stations, recording equipment manufacturers, and studios.

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Technicians

We now have openings for work
in the fabrication and processing
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Applicants should be high school graduates with a natural aptitude for making small parts. Experience in electronics, precision machine work and experimental tube work is desirable.

Address resume of
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California

Indo-China (Vietnam) — Radio France-Asie, 6.116A, Saigon, noted 0600 with news in French; on 11.9 with news 2030. Hanoi, 7.405, noted 0630 with French program; is Radio Hirondelle. (Sanderson, Australia) Saigon, 9.750A, noted opening 0600 with "La Marseillaise," heard on 11.935A at 1000-1115 at strong level (Ishikawa, Japan) Radio Laos is heard at fair strength on 7.215 around 0800 to closedown 0923 with "La Marseillaise." "Voice of Vietnam," Saigon closes down around 0958-1001 and then announces use of 9.620, 7.288, 4.960; however, latter is heard on 4.960 (Japanese Short-Wave Club)

Iraq—Radio Baghdad, 11.725, noted around 2308 in Arabic. (Bellington, N. Y., others)

Israel—Tel Aviv, 9.010A, noted with "Voice of Zion" relay from Jerusalem 1515-1600 closedown; asks for report to Box 754, Jerusalem, Israel. (Man N. Y.; Bjornert, Sweden, others)

Jamaica—Radio Jamaica verified 3.360 with QSL card in two colors green and black. (Klein, Va., others)

Japan — The Far East Network (AFRS), Tokyo, is scheduled 1600-0645, JKL2, 9.605, JK16, 11.825; 0500-1000, JKL, 4.860, JK13, 6.080. (Scheuer, N. J.) JOA6, 15.135, JOA4, 11.700, noted opening in English to Western North America 0000. (Hooker, Alberta) JOA3, 9.675, heard 0600 with news. (Sanderson, Australia)

Luxembourg — Radio Luxembourg by now should have its new 50 kW transmitter on the air on 6.090 0040-0930, 1045-1700 in French. (ISW London, others)

Madagascar — Radio Tananarive 9.515, noted with interval signal 2220 signed on 2231 with "La Marseillaise."

Malaya—Forces Broadcasting Service, 5.010, Singapore, 7.5 kw., is scheduled 0645-0659 with tone; 0700-0715 Swahili, Chinyanja; 0730-0800 Fijian 0800-0900 Gurka; English is to be added shortly. (WRH, others)

Mexico—XEHH, 11.880, very strong 1745 with call in Spanish. (Norman N. C.)

Monaco — Radio Monte Carlo 7.349A, noted closing 1800 (some days earlier). (Cox, Dela.)

Mozambique—CR7BJ, 9.768A, Lourenco Marques, still noted with English from 2300 opening (from 0000 Sun) (Littlefield, Mass., others) Heard 4.920AV at 1750 with popular music and English announcements; ended with Ted Lewis' "Goodnight Waltz" at 1800. (Cox, Dela.) Lourenco Marques, 4.872, noted with news in Portuguese 1500, then music, closing announcements after chimes and can play "A Portuguesa" and signed on 1514. (Pearce, England) Heard singing on in Portuguese on 11.952A 0000, weak level in Ind. (Niblack)

Nepal—Still uses 7.10 with English 0845-0900. (Etersvep, Sweden)

New Zealand—Heard closing 0600 on 9.540. (Middleton, Ohio)

Nigeria—Radio Nigeria is to increase power to 20 kw. shortly. (F. N. Z., via Radio Australia)

Norway—LLG, 9.61, Oslo, noted 2300-2400 (Sun. to 0020) with "Norway This Week" in English to West st., excellent level. (Riggs, Balbi, Calif.) Channels may be used during the year are LLQ, 21.730; LLP, 70; LLN, 17.825; LKW, 17.755; LLM, 15.175; LKV, 70; LLK, 11.850; LKQ, 11.735; LLH, 9.645; LLG, 9.610; 9.550; LKJ2, 9.540; LLR, 7.240; LLS, 7.210; LLI, 15; LKJ, 6.130; LKF, 1578 kc. (Hornstein, Mich.)

Pakistan—Radio Pakistan noted on 17.770 with news 0-0210; in English 0515-0530 on 17.835. (Fernell, den) Noted with news 0330 and Western music 0400 17.710; news 0730 near 17.750 now. (Pearce, England) Heard on 9.645A with English for Turkey 1430-1530 and Britain 1530-1615. (Pearce, England, Bellington, N. Y.) Heard parallel on 11.885, 15.335 at 2035 tune-in with radio music for Southeast Asia. (Bellington, N. Y.) Heard during 0630 on 15.27, 17.770, much native music. (Takai, Japan)

Panama—HOLA, 9.505, Colon, noted recently 2200-2400 redown. (Gay, Calif.) Heard in English 2130. (Hornstein, Mich.)

Peru—OAX4H, 6.307, Radio Mundial, Lima, noted with news in Spanish 2130. (McPhadden, Calif.)

Philippines—DZH3, 9.500, heard around 0700; uses commercials. (Stark, Texas) The Far East Broadcasting Co., Manila, reports that the two new 10 kw. transmitters—for use on 9.730, 11.855—are on order; one will be ready by fall, the other several months later; a new transmitter on 21.475 is expected to be in operation within a year; their power will be given all transmitters gradually. (Heiner, N. J.) DZH9, 11.855, heard best in Alberta 10-1200; noted closing 1203. (Hooker) DZ16, 17.804, heard 0130 with religious program in progress. (Sanderson, Australia) DZH2, 9.640, Manila, noted 0600 at good signal in Tokyo with news. (Ishikawa, Takemi)

Poland—Radio Warsaw, 9.57, noted in English 1715-20, strong signal. (Wade, Fla.)

Portugal—Emissora Nacional, Lisbon, is reported on three new channels in the 25-m. band—11.797, 11.760,



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Front in the High Quality Amherst Field Parade 1934
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11.835. (WRH) The 11.835 channel noted in Indiana at 1430. (Niblack) Signs on 1230. (Pearce, England)

Reunion—Radio St. Denis is heard in Sweden on 7.170 around 1625. (Radioklubben Universal, Sweden)

Saudi-Arabia—Djeddah now broadcasts on 725 kc., 3.960, 3.980, 5.975, 6.175, 7.245 at 2305-2335, 1045-1135, 1215-1335, and on 725 kc., 3.950, 5.975, 7.245, 11.850, 11.950 at 0605-0635. (WRH) (The 41-m. channel more recently has been heard around 7.300A instead of 7.245.) Noted by Pearce, England, opening with interval signal 1030 on 11.850A.

South Africa—Cape Town, 5.892A, noted 0110-0125 with morning produce market quotations in English. (Gay, Calif.)

South Korea—Radio Korea informs Scheiner, N. J., that the new 10 kw. short-wave and medium-wave trans-

mitters to operate as Radio Seoul are still under construction; the 9.555 outlet in Seoul is still 300 watts, and there is another outlet there—HLKA, 3.8925, 1 kw.

Spain—Madrid, 9.363, noted in English for North America 1800-1840. (Middleton, Ohio, others) Measured 9.359 recently. (Roberts, Conn.)

Switzerland—HED5, 15.120, Berne, noted 1145 with English. (Mast, N. Y.)

Tahiti—in verifying, Radio Tahiti, Papeete, listed FO8AA, 6.980, 200 w.; FZP8, 6.135, 1 kw. Both use half-wave antennas. (Kary, Pa.)

Thailand—Bangkok, 6.240, heard with news by man 0515; 7.105 heard 0700 when identified in English.

Trinidad—Radio Trinidad, 6.085, noted 0515 when identified. (Stark, Texas) Heard closing 2202 with "God Save the Queen" on 3.275; good level, slight heterodyne. (Cox, Dela.)

RCA'S PRINTED-CIRCUIT COMPONENTS

THE tube department of Radio Corporation of America has announced the development of a series of printed-circuit components which is expected to stimulate the production of more compact and efficient radios, TV sets, and communications gear.

These new components—six 40 mc. i.f. transformers, coils, and traps—are produced by a special photo-etching process which makes possible virtually limitless production of identical electronic circuits from a single photographic negative.

Conventional inductors depend upon coils of handwound or machine-wound copper wire to provide the desired inductance values—the exact values are largely determined by the number of turns of wire, its spacing, and the diameter of the coil form. With the printed circuit method, both the copper wire and the wire-winding operations are

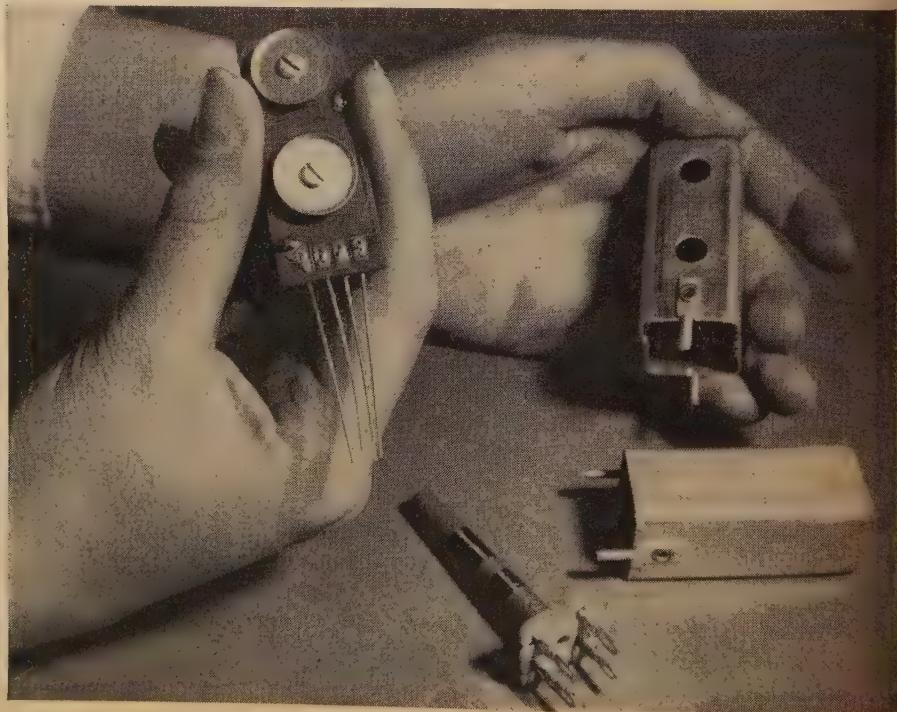
eliminated. Inductances are provided by flat inductors having rectangular windings which are photographically printed on copper-clad plastic strips.

Although these RCA printed-circuit components are intended for applications in home television receivers, the same photo-etching process can be used to print circuits for components used in a wide range of radio and communications equipment.

The new components are i.f. types designed for television sets utilizing intercarrier sound systems and incorporating picture i.f. and sound i.f. carriers of 45.75 mc. and 41.25 mc., respectively. The presently-available components include a first video i.f. grid-circuit coil and trap; a first video i.f. plate-circuit coil; a second video i.f. grid-circuit coil; first and second video i.f. filter traps; second video i.f. transformer; and third video i.f. transformer.

-30-

RCA's "Tandem" 40 mc. printed-circuit i.f. transformer used in home TV sets. A standard wirewound transformer is shown on table to permit a comparison of size.



C 2A7.	89c	GA4G	1.89	GDH6	69c	6K5GT	.69	6S07	59c	7C5	.89	12AU7	.79	12SN7GT	.99	26	59c	57	79c	SPECIAL			
19 2B3		GA5K	.89	GDH6	1.08	6B6KT	1.19	6K7GT	.59	6S07GT	.7C5	12AV6	.59	12S07	.27		58	58	70L7	1.49			
19 2B7		GA5L	.89	GDH6	1.08	6B6KT	1.19	6K8GT	1.19	6SS3	.99	7E5	.89	12AR7GT	69c	35A5	.99	70L7GT	1.49				
19 2C34		GA60	6.00	GDH6	1.19	6L6G	1.19	6L6G	6.00	6T7G	1.15	7E6	.89	12AX4	.69	1223	.95	35C5	71A	.87			
35 2E5		GA60	.89	GDH6	.81	GDH66	1.19	6L6G	.89	6T7	.89	7E7	.99	12AY7	.95	14AF7	.93	35L6	75	.79			
29 2X2/879	74	GA607	1.25	GDH667	1.19	GDH667	1.19	GDH667	1.25	6U5	7F7	.99	12AY7	.95	14AF7	.93	35W4	.59	77	.69			
39 3LP4		GA65	.79	GDH67	1.29	GDH67	1.19	GDH67	69c	6X8	7F8	1.47	12BA6	.59	14BG6	.59	35Y4	.99	78/5D6	1.10			
304		GA65T	.69	GDH67	.89	GDH67	1.19	GDH67	69c	6X8	7F8	1.19	12BA7	.19	14BB8	89c	35Z3		80	.69			
305GT		GA65S	.89	GDH67	1.19	GDH67	1.19	GDH67	.59	6U5	.89	7H7	1.05	12BF6	69c	14C5	.125	35Z4	.75				
354		GAU5GT	1.29	GDH67	.59	GDH67	1.29	GDH67	69c	6V3	7H7	1.29	12BH7	1.19	14CF7	.112	35Z5	.55	83	.145			
19 3V4		GAU6	.59	GDH67	1.19	GDH67	.59	GDH67	69c	6V6GT	.89	7H7	1.29	12BH7	1.19	14F7	.105	35/51	.79				
19 5T4	1.40	GAU5GT	.89	GDH67	1.19	GDH67	.59	GDH67	69c	6W4GT	.59	7L7	7S	12BY7	.89	14FB8	.145	84/624	.72				
59 SU4G		GAU6	.59	GDH67	1.29	GDH67	.59	GDH67	69c	6W5	.89	7H7	6S7	12BY7	.89	14FH8	.106	85	.79				
9 SW4	87	GAU6	.69	GDH67	1.29	GDH67	1.29	GDH67	69c	6X4	7H7	1.15	12EX4	.65	14Q7	.105	35Z6	.93	VR90	\$1.19			
9 SW4GT	59c	GAU6	1.05	GDH67	1.29	GDH67	1.29	GDH67	69c	6X8	7H7	1.19	12EX4	.65	14Q7	.105	VR105	88c	VR150	29c			
19 SW4GT	69c	GAU6	1.05	GDH67	1.29	GDH67	1.29	GDH67	69c	6X8	7H7	1.19	12EX4	.65	14Q7	.105	2T51	29c					
19 5Y3GT	.45	GAU5GT	.89	GDH67	1.15	GDH67	1.15	GDH67	69c	6Y6G	.69	7V7	1.19	12K7GT	1.89	18B6G	.43	7T52					
5Y4G	.54	GAU6	1.44	GDH67	1.15	GDH67	1.15	GDH67	69c	6ZD7GT	.99	624/84	1.19	12K8B	.89	18B6G	1.89	7T52					
5X4G	81c	GAU6	1.45	GDH67	1.15	GDH67	1.15	GDH67	69c	6SF5	.59	7A4	9.5	12Q7GT	.89	19T8	.45	117L7	.140				
523		GAU6	.59	GDH67	59c	GDH67	.59	GDH67	69c	7A5	1.19	7X7	1.25	12SA7GT	.69	24A	.66	117N7	.195				
643	1.68	GAU7	.89	GDH67	1.59	GDH67	1.59	GDH67	69c	7A6	.89	7V4	1.29	12SK7GT	69	25Z5	.69	117P7	.195				
647	1.21	GAU6	.69	GDH67	1.59	GDH67	1.59	GDH67	69c	7A7	1.29	7Z4	1.25	12SK7GT	69	25Z6GT	.69	117Z6	.119				
99 6A8GT	69c	GAU6	1.05	GDH67	1.59	GDH67	1.59	GDH67	69c	7A8	1.29	7Z4	1.25	12SK7GT	69	25Z6GT	.69	2T51	29c				
648	1.05	GAU6	.89	GDH67	1.59	GDH67	1.59	GDH67	69c	7B4	.89	12A27	1.59	12FS5GT	.69	25B6GT	.105	2T51	.775				
649	1.05	GAU6	.89	GDH67	1.59	GDH67	1.59	GDH67	69c	7B5	.89	12A27	1.38	12SG5	.89	25L6GT	.59	866A	.149				
645GT	1.15	GAU6	.89	GDH67	1.59	GDH67	1.59	GDH67	69c	7B6	.89	12A25	.54	12SH7GT	.69	25W4GT	.139						
524	1.45	GAU6	.89	GDH67	1.59	GDH67	1.59	GDH67	69c	7B7	.89	12A27	1.59	12IS7GT	.69	25Z5	.69	1299					
647	1.05	GAU6	.89	GDH67	1.59	GDH67	1.59	GDH67	69c	7B8	.89	12A27	1.59	12SK7GT	69	1619							
648	1.49	GAU6	1.89	GDH67	1.59	GDH67	1.59	GDH67	69c	7C4	1.30	12AUG	.69	12SL7GT	69	25L6GT	.115	50Y6	.99	2051	1.15		

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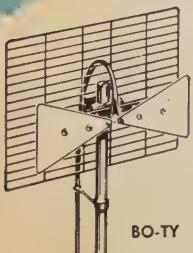
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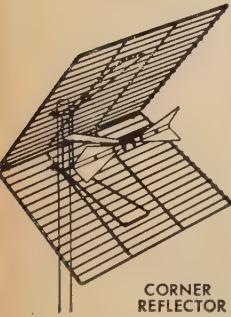
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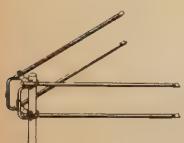
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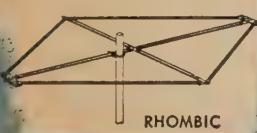
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YAGI. There are 11 custom models of the YAGI for top reception across the entire UHF band. Each features extremely high gain on its assigned channels as well as a strong forward radiation pattern.

Turkey—Radio Ankara noted in English 1600-1645 on 15.160 to Western Europe, Britain. (Golden, Mac others) Still has powerful signal in English to North America daily 1815-1700 over TAT, 9.515. (Wade, F. Oestreich, Wash. State, others)

Uruguay—CXA19, 11.835, Montevideo, noted 1715 good level with music. (Cox, Dela.) CXA10, 11.909, Montevideo, is good level daily around 2100. (Norman, Ferguson, N. C.)

USI (Indonesia)—Djakarta, 9.710, strong with news 0900, 0945. (Hooker, Alberta) Heard opening 1400 after chimes on 11.785 to Europe-New Zealand; announces 9.710 parallel in this beam which closes 1500. (Pearce, England)

Western Samoa—By this time, Apia should have tests on 6.040 and (later) 3.241; probably will settle down on one of these channels and may follow the m.w. schedule of 1700-1900 Sun.-Wed.; 2200-2300 Sun.-Wed.; 0230-0330 Mon., Wed., Sat., 0230-0530 Fri.; 0330-0430 Sun. (Scheinerman, N. J.)

Zanzibar—The Information Officer, Box 344, Zanzibar, forms Scheiner, N. J., there is one station operating in that country—"Sauti ya Unguja," 4.795, 250 w., 1000-1030 in Swahili only.

* * *

Press Time Flashes

Radio Somali, 7.125, Brt. Somaliland, is on the air 0800-0930; all-Somali language; transmitter is RCA type R-4331 with nominal output of 1 kw.; uses half-wave dipole antenna. (Radioklubben Universal, Sweden)

Forces Broadcasting Service, Tripoli, has been on the air around 1845 on 4.785; closes 1600A with "God Save the Queen." (Pearce, England)

More recently, **Radio Africa**, Tangier, has been using 7.193 again instead of 7.126; noted 1030 with popular music. (Pearce, England)

Damascus, Syria, has been noted recently on 11.720 around 1900-2100 closedown (parallel 11.913A), evidence to Latin America. (Niblack, Ind., Bellington, N. Y.)

HS8JS, Thai Army Radio, Thailand (Siam) is heard fair strength 0630-0700 on 4.870; programs in Thai. (Cushen, N. Z.) **ALF**, 9.915A, Juneau, of the Alaskan Communications System, noted testing 2230 at excellent level. (Niblack, Ind.)

Ishikawa and Takemi, Japan, say **Radio Free Japan** Red-Chinese operated, heard on 11.896 and 10.180 at 0830 in Japanese; location is North Korea; strong level Tokyo.

Radio Pakistan, 11.884A, lately has had news 2030 (Ferguson, N. C.)

The new s.w. VOA relay station at Salonika, Greece, scheduled on 6.040 at 1215-1645 to Europe; 7.270 at 0945, 1730-0130 to Europe; 11.735 at 0900-1230 to US Middle East. URDXC says is 35 kw.

Cairo, Egypt, noted on measured 11.966 around 1920-2046 closedown; seems parallel 6.085 (Ferguson, N. C.). (Niblack, Ind.; Bellington, N. Y.)

At press time, Balbi, Calif., reported Peking, 6.200 weak 0400 with news; 7.50 fair, 10.26 weak, 11.67A fair, 6.200 good level 0500 with Home Service. USSR heard China from 0230 on 15.11, 11.72, 11.75, 9.725, 9.66, 9.61, 6.055; signing off 0900.

Catch, England, flashed he had noted Lisbon, 9.742, on 15.160, excellent level; ZPA5, 11.950; Encarnacion, Paraguay, fair level 1645; ZYP23, 5.045, Petropolis, Brazil, 1725; a station, probably the Yugoslav Emigrant Station, noted opening with march 1720 on 6.283, and clandestine **Radio Espana de Independiente**, noted on 10.280 around 1730. And Niblack, Ind., noted CE1173, Santiago, Chile, at 1940-2030 on 11.945AV one day, next on 11.965A.

* * *

Acknowledgement

Thanks for FB reports! **ISW DEPARTMENT** monitoring certificates for 1953-54 are now available—*gratis* to reporters to the Department. Send reports and requests for monitor's certificates to Kenneth R. Board, Stewartstown Road, Morgantown, West Virginia, U.S.A.

"PAY-AS-YOU-WATCH" SYSTEM

Office Television's new closed-circuit transmitter for makes possible retransmissions on Channels 2 through 13.

Never-mounting cost of television program sponsorship is causing more companies to cast a live eye at the various "TV-for-systems which have been developed in the past few years. Though not as yet sanctioned by FCC, several companies are progressing with the development of equipment to handle this type of transmission.

ong the new items on the market is Boxoffice Television's "Picturecast", a unique closed-circuit transmitter for television pictures and

unit accepts video and audio from any source—a receiver, camera, coaxial line, generator, etc. and admits them into any type of transmission line on any v.h.f. channel 2 through 13. The transmitter frequency is crystal-controlled, with sound and video carriers automatically maintained 4.5 mc. apart. Test results with intercarrier receivers. AM pictures and FM sound receivable on all standard TV

system as it operates now, in conjunction with master antenna system is inexpensive and easily installed and operated.

audio and video are piped by a

Max Goodman, president of United Elco Data contracting firm specializing in hotel master antenna system installation, installs the decoding key in the rear of a television set equipped to receive Boxoffice Television's closed-circuit TV.

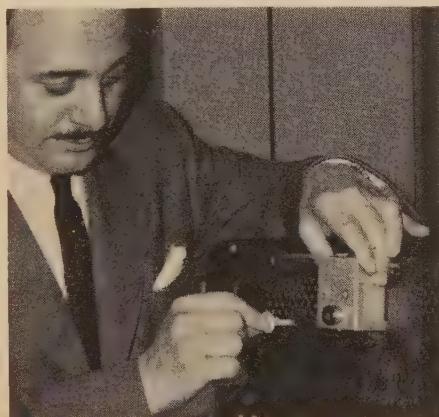
Hunting, treasurer of Bell Television, master antenna TV system operating is shown with a demonstration set incorporating the new "Picturecaster" in the TV set with which it is employed.

common carrier (such as telephone company lines) to each master antenna system which is part of the network. These normal signals are then fed into the "Picturecaster" which scrambles the picture so that while it can be tuned in in the normal way it cannot be viewed.

The special decoder with which the receiving set is equipped consists of an inexpensive tube circuit, which is installed in one of the receiver's existing tube sockets, and a box with a keyhole.

To view an unscrambled picture, the user inserts the key in the keyhole and the picture comes in clear. Keys can be rented for various periods of time, the rental depending on the program material to be received. The key rental is the fee for watching the program. Removing the key scrambles the picture again so that a single key cannot be used to operate several receivers.

The equipment is undergoing extensive testing at the present time in anticipation of an FCC OK on "Pay-As-You-Watch" programming. —30—



there's always
something
new
being developed
by Perma-Power



- NORMAL LINE VOLTS
 - 10 VOLTS INCREASE
 - 10 VOLTS DECREASE
- 300 WATTS**

List Price
\$6.75

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Perma-Power COMPANY Chicago 25, Ill.
Manufacturers of Electronic Equipment Since 1928

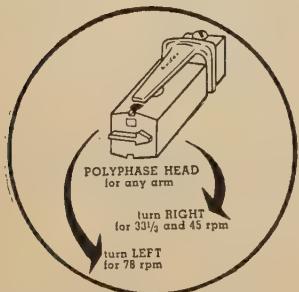
"In music, listening quality is everything . . .

1 It is the No. 1 MUST. Without it everything else becomes meaningless. The AUDAX CHROMATIC has that quality to a degree not equalled by any other pickup" . . . so says violinist David Sarser, of MUSICIAN'S amplifier fame (Toscanini's NBC Symphony).

2 Be it diamond or sapphire, every stylus has a limited life-span; the diamond lasts the longer. Obviously, then, replaceability of the stylus—at home—is of the greatest importance.

3 But . . . only YOU can decide what sounds best to you. Therefore, See and Hear the Audax CHROMATIC and—You be the judge . . . yet Audax costs no more than ordinary magnetic pickups.

ONLY AUDAX PROVIDES HOME REPLACEABILITY OF EITHER STYLUS, INDEPENDENTLY OF THE OTHER.



One single magnetic unit plays all home records

Available with the New Compass-Pivoted Audax arms and to fit the high quality record changers.

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AUDAX COMPANY
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Creators of Fine Audio-Electronic apparatus for over 25 years

"The Standard by Which Others Are Judged and Valued"

MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

INDICATOR LIGHTS

Dialight Corporation, 58 Stewart Ave., Brooklyn 37, N. Y. is currently offering a copy of its new brochure, L-153.

This four-page publication describes and illustrates the company's line of subminiature indicator lights for various applications. Units described fall into five general categories: for plastic plate edge lighting, indicator lights, dimmer types, light shield, and indicator lights with "press-to-test" feature.

When writing for a copy of this brochure, address your requests to Mr. E. Greene of the company.

REPLACEMENT GUIDE

Standard Transformer Corporation of Chicago has prepared a "Tape-Wire Recorder Replacement Guide" which lists sixty-three models by twenty-two companies manufacturing tape and wire recorders.

The Guide has been published to meet the need for authoritative information on power transformer, filter choke, and audio output transformer replacements, according to the company.

Manufacturer and model number, manufacturer's part number and Stancor part numbers are listed for all models included in the Guide.

Distributors and service technicians may secure a copy of this guide by writing the company at 3580 Elston Avenue, Chicago 18, Ill.

CONVERTER AND BOOSTERS

Electro-Voice, Inc. of Buchanan, Michigan has issued a new bulletin covering its u.h.f. converter and v.h.f. booster line.

Features, specifications, and other details on these products are covered in Bulletin No. 182. Information on the company's 3300 u.h.f. converter, "Tune-O-Matic" and "Tenna-Top" boosters is given in detail.

U.H.F. BOOKLET

How its signal generators can be adapted for u.h.f. applications is the subject of a new booklet, "How to Use the Simpson 478-480 for U.H.F. Alignment", currently available from Simpson Electric Company, 5200 W. Kinzie Street, Chicago 44, Ill.

The booklet describes how the company's v.h.f. test equipment can be adapted for use in u.h.f. service work. By following the instructions given in the publication the technician can obtain signals of the type, accuracy, and strength necessary to identify the nature of troubles in u.h.f. circuits.

Copies of this booklet are available without charge from the company.

TRIAD TRANSFORMERS

The new catalogue just released by Triad Transformer Corporation, 4055 Redwood Avenue, Venice, California lists more than 500 items of interest to technicians.

The publication features an expanded line of TV components, industrial transformers including oids, pulse transformers, transistors, and additional miniatures. The catalogue also contains a geophysical section.

Copies of Catalogue TR-53 may be obtained by writing the company direct.

DISTRIBUTOR CATALOGUE

Dealers and technicians, in addition to the company's distributors, are currently receiving copies of the 1953 Mallory distributor Catalogue No. 553, according to the company.

The new publication lists and describes more than 2200 items, many replacement components which are handled through the company's distributor system. For the first time the catalogue also includes list prices of the items covered.

A copy of this new catalogue may be obtained by writing to P. R. Mallory & Co. Inc., 3029 E. Washington St., Indianapolis 6, Ind.

ANTENNAS AND ACCESSORIES

A 36-page catalogue of television antennas and accessories has been issued by Radio Merchandise Sales, Inc., of 2016 Bronxdale Ave., New York 60, N. Y.

The new publication covers items necessary for receiver installation from the rooftop to the set itself. The catalogue contains a general alphabetical index which provides logical breakdown of accessory categories which helps speed the location of the desired parts.

As a further aid to the technician for whom the catalogue is intended, RMS has included a technical section. Copies of this publication are available from the company's distributors or from the company itself.

"GLASSEAL" CATALOGUE

A new 20-page catalogue covers the company's line of "Glasseal" condensers. It has been issued by Pyramid Electric Company, 1445 Hudson Boulevard, New Bergen, N. J.

Designated as Catalogue PG-3, this new publication contains complete

ng data, performance curves, construction styles, sizes, capacitance, voltage listings for the subminiature units.

es of this two-color catalogue available without charge upon request direct to the manufacturer.

TUBE CHARACTERISTICS

Receiving Tube and TV Picture Divisions of *Sylvania Electric Products Inc.*, 1100 Main Street, Buffalo, N. Y. has released new versions of characteristic booklets. The two sets, revised and brought up-to-date, are available without charge and can be obtained through the company's distributors or the company's Advertising Distribution Department at the above address.

"Television Picture Tube and
General Purpose Cathode Ray Tube" char-
acteristic chart has been revised
to include the latest modifications,
changes, etc. Over 30 tube types
have been added, which brings the
total types listed in the booklet to
150. There are 56 different base
diagrams accompanying these
types.

revised "Radio and Television
Tubes" booklet includes, in
addition to previously listed types, the
television receiver and sub-
picture tubes. Over 750 different
tube types are listed in
chart along with their basing
charts.

NEEDLE REPLACEMENTS

Recoton Corporation, 147 West Street, New York, N. Y. has issued a 1953-54 edition of its "Simpler Reference Guide to Replacement Parts."

igned to assist dealers in selecting the correct replacement part, the catalog is thoroughly cross-indexed for reference.

Ties are available without charge
the company on request.

DEALER AID

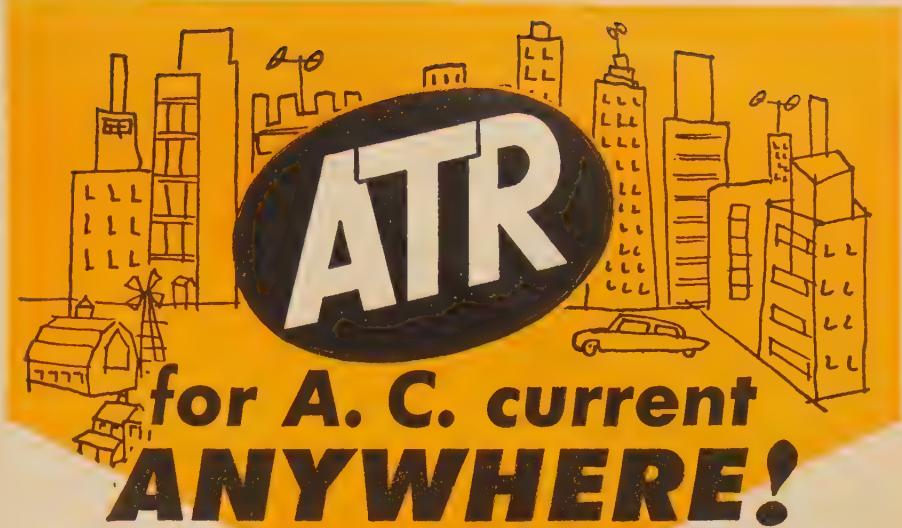
New thermometer designed to attract the attention of customers of radio and television dealers is now available from parts distributors of True Products Co., 51 Marshall St., North Adams, Mass.

elve inches in diameter, the eas-
sible face is finished in charac-
tic Sprague orange and blue.
her-sealed in an aluminum case
utdoor as well as indoor use, this
rometer is available to radio and
ision service technicians through
prague jobbers or may be ob-
postpaid by sending a \$4.00
or money order to the company.
for Thermometer D-114.

U.H.F. ACCESSORIES

sley Electronics, Inc. of 8622 Charles Rock Road, St. Louis 14,ouri is currently offering a copy new catalogue which lists and ibes the company's line of tele- n installation accessories. catalogue 53-54 offers several of

July 1953



**AT NEW
LOW COST**

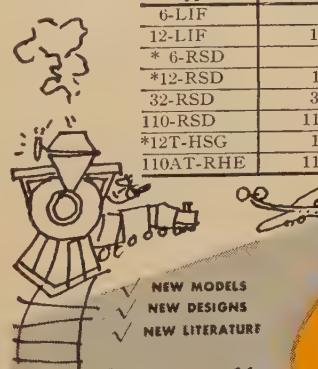
\$2555
And Up
Retail Price

INVERTERS

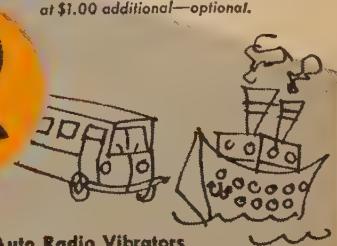
For Inverting D.C. to A.C. . . . Specially Designed for operating A.C. Radios, Tape Recorders, Wire Recorders, Record Changers, Television Sets, Amplifiers, Address Systems, Radio Test Equipment and most small electrical and electronic devices from D. C. Voltages in Vehicles, Ships, Trains, Planes and in D. C. Districts.

Type	Input DC Volts	A.C. Output 60 Cycles	Output Int.	Wattage Cont.	Consumer Net Price
6-LIF	6	110 volts	40	35	\$25.55
12-LIF	12	110	50	35	25.53
* 6-RSD	6	110	85	75	39.25
*12-RSD	12	110	125	100	39.25
32-RSD	32	110	150	100	39.25
110-RSD	110	110	250	150	39.25
*12T-HSG	12	110	250	200	96.45
110AT RHE	110	110	325	250	56.95

* Available with leather carrying handle



*See your jobber
or write factory*



"A" Battery Eliminators, DC-AC Inverters, Auto Radio Vibrators

AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA—U. S. A.

ided in the booklet is information on the company's Type 2N32 point-contact transistor for use in low switching applications where operating frequency for voltage cut-off of .9 mc., an operating frequency for current-gain cut-off of 1.5 mc., and a high current amplification factor are important design considerations.

Type 2N33 point-contact unit used in oscillator service at frequencies up to 50 mc. is also described. Types 2N34 and 2N35 junction transistors of the p-n-p and n-p-n type respectively are covered in some

of the four types has a base with three small pins in line and used to provide mechanical index or socket insertion. —30—

HOW MUCH IS YOUR LABOR WORTH?

INFORMATIVE little booklet is available to all radio and television technicians from the How-Sams Co., 2201 E. 46th St., Indianapolis, Ind. The publication offers an intelligent approach to the setup of labor costs for service establishments of varied requirements.

written by Donald B. Shaw, vice-president and treasurer of the company, booklet is a "must" for all service operators. It contains information on the simplest possible ways of setting labor and assuring compensation for time and business expenses operation of a one-man shop. It explains "productive labor" (the performed on a repair job for you can charge a customer at a rate). These examples are also on a one-man shop.

Shaw demonstrates how these general principles may be applied as an owner adds personnel. The set concludes with a discussion of allocation of overhead expenses to profitable departments of the business. —30—

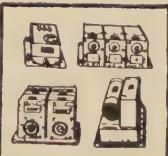
meteoric rise of the Heath Company of Harbor, Michigan continues unabated. The firm announces the opening of a new plant which more than doubles its facilities for the design and production of all of test equipment in kit form. The building houses enlarged laboratory areas, assembly lines, and office space necessitated by increased business.



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ARC 5 EQUIPMENT:



TRANSMITTERS	
4 to 5.3 MCS.	\$8.95
5.3 to 7 MCS.	\$7.95
All above complete with all tubes and crystal, in excellent condition.	
R-4, ARC-5 RECEIVER— 334-250 MC'S	
Complete with all tubes and dynamotor. Excellent condition.	\$19.95

COMPONENTS	
MOUNTING RACKS	
Single Trans... \$1.00 Ea.	
Double Trans... \$1.75 Ea.	
RE-2ARC-5 ANTENNA RELAY UNIT	
Complete with Meter and 50 MMFD vac. cond.	\$4.50
MD-7/ARC-5-PUSH PULL MODULATOR UNIT Comp. w/tubes and dynamotor. Exc.	\$11.50

MIDGET SELVYN'S	
AY-6 type operates from 6-12 Volts 60 Cycle. Use as both transmitter and receiver. These compact little units draw almost no current and work fine for all remote position indicating applications. OD 2 1/4" x 2 1/4" x 2". Has spring return shaft. All New (Appr. wt. 1 lb.)	
Each \$2.50	
AY-5 Type, same as above but has a continuous rotating shaft. These compact units are all new.	\$4.95

ARMY AMMUNITION CANS	
Type M-3 50 Cal. Cans 12" Long x 6"	
Wide x 7 1/2" Deep.	
Type M-1 Cans 16 1/2" Long x 3 1/2" Wide x 8 1/2" Deep.	
All aluminum with Leather Handle and Hinged Top with hasp. Use for all your small parts or tools. O.D. Color, clean them and buff or paint.	
Each \$1.50	

BK-22 RELAY UNIT	
Part of Radio Compo Equipment. Contains 1-12 V. D.C.P.T. Leach Relay and 1-Solenoid operated 10 pole double throw switch. Terminal mountings on back of unit. All enclosed aluminum housing.	
Brand New.	
Each \$5.95	

CRYSTALS	
FT-241 54th Harmonic Type. Fundamental Frequencies listed below in KC.	
370 .390 410 .430 449 .469 486 .508	
372 .392 412 .432 451 .470 488 .510	
374 .394 414 .434 453 .471 490 .512	
376 .396 416 .436 454 .473 492 .514	
378 .398 418 .438 456 .475 494 .516	
380 .399 420 .432 458 .476 496 .518	
382 .400 422 .432 459 .479 498 .520	
384 .402 424 .444 462 .480 502 .522	
386 .404 426 .445 464 .482 504 .524	
388 .406 428 .447 466 .484 506 .526	
Each Frequency .59¢ Ea.; 3 for \$1.50; 6 for \$2.70; 10 for \$4.00	
500 KC. .59¢ Ea.; 3 for \$1.50; 6 for \$2.70; 10 for \$4.00	

12 VOLT BLOWER MOTOR	
The famous Craftsman Blower, used on boats, etc. Ideal for Engine Room use. An motor is completely enclosed and Sparkproof. 4" outlet.	
All Brand New.	
Each \$9.95	

ARC-4 TRANSCEIVER	
140-144 MC. Ideal for 2 meters. Complete with 20 tubes and control box.	
BRAND NEW.	
\$29.95	

WILLARD 2 VOLT RADIO BATTERY	
NEW. Uncharged (Appr. wt. 4 lbs.) TYPE 20-2... Ea.	\$2.50
Complete set of three with Box and Connections to make a 6 volt, 20 Amp. Hrs. Battery Uncharged	
(Appr. wt. 15 lbs.) ... Set \$8.95	
2 VOLT VIBRATORS. VBBA Synchronous Type. Used in all portable radios having 2 volt wet cell supply. All new.	
Ea. \$1.00	

AIRCRAFT HEATERS	
Stewart-Warner Gasoline Heater with 24 Volt Blower Motor attached 8.5 M.B.T.U. Per Hour.	
All in Excellent Condition.	
Each \$4.95	

12 VOLT GENERATOR	
Same generator as used in Trucks and Tractor Units. 12 Volt 25 Amp. with 1-Pole field for connection to motor or generator. Used.	
Each \$12.50	
SOUND POWERED HEAD AND CHEST SET	
Used same way as Hand Set except you have freedom of supply. No Batteries or power source required for operation. Excellent Condition.	
Per Pair \$11.95	

HOBBY MOTORS	
Operates from 110 Volts, 60 Cy., AC. Gears Motors. 3 Speeds: 4,000 RPM., 200 RPM., 5 RPM. Best for model airplane work. Used for Bar-B-Que spits. Home Work shops or any low speed application. Each speed on a separate shaft. Can be used separately or at the same time. All New.	
Each \$12.95	
CAPACITORS • FIXED • OIL FILLED	
AI D.C. VOLTAGE RATINGS	
2 MED. 400 V. 1.95 1 MFD. 1000 V. \$1.00	
3X3 MFD. 400 V. 1.95 2 MFD. 1000 V. 1.25	
10 MFD. 400 V. 2.95 8 MFD. 1000 V. 2.00	
4 MFD. 600 V. 1.95 10 MFD. 1500 V. 1.95	
5 MFD. 600 V. 1.95 4 MFD. 1500 V. 2.25	
6 MFD. 600 V. 1.95 6 MFD. 1500 V. 2.95	
7 MFD. 600 V. 1.95 1 MFD. 2000 V. 1.95	
8x8 MFD. 600 V. 2.25 2 MFD. 2000 V. 1.95	
10 MFD. 600 V. 2.25 3 MFD. 2000 V. 2.50	
15 MFD. 600 V. 2.95 1 MFD. 3000 V. 3.95	
20 MFD. 600 V. 2.95 1 MFD. 5000 V. 5.95	

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12 VOLT GENERATOR	
Famous "Jeep Generator," 12 Volt, D.C. at 55 Amp. Complete with charging ammeter and 55 Amp. Voltage Regulator. All in enclosed housing. Use for Boats, Trucks, Tractors or Mobile Radio. In excellent condition.	\$55.00

REVERSIBLE MOTOR	
1/40 H.P. Ball-bearing 3450 R.P.M. in Blast-proof case. Needs only a capacitor for starting. All Brand New. 110 V., .75 A. \$4.95 Starting Capacitor.....\$0.69 Ea.	

DRY BATTERIES

New shipment of recent Expiration Date Surplus Batteries. All Checked.

TYPE	NO.	VOLTAGE	EACH	TEN
BA-5J	67 1/2 V. Portable Batt.	.75	\$6.50	
BA-37	1 1/2 V. Handie Talkie Batt.	.75	2.00	
BA-18	10 1/2 V. Heavy Talkie Batt.	.75	7.00	
BA-56	45 V. Portable Batt.	.60	5.00	

PROP PITCH MOTORS	
For your Beechentenna: 10 Volt to 32 Volt, A.C. or D.C. 1/4 H.P. to 1/4 H.P. Reduction 6000 to 1. RPM. ALL BRAND NEW. Each \$16.95	

MODEL GO-9 TRANSMITTER

ONLY A FEW LEFT	
All brand New. 100 Watts CW or MCW. emission. Operates from 110 V., 800 Cycle, easily converted to 60 Cycle operation. Low frequency range, 300 KC. to 600 KC. High frequency 3,000 KC. to 18,000 KC. using an E.C.O. We furnish complete conversion data with each transmitter.	
Complete with schematics.	
	\$59.95

NEW 12 VOLT BATTERIES

FOR MOBILE OR LIGHT AIRPLANES, IN ORIGINAL BOXES. WEIGHTS 37 LBS. SIZE: 5 1/2" wide x 10" long x 10" high. SIGNAL CORPS TYPE BB-53, 12 VOLTS, 32 AH.	
	A real terrific surplus value \$9.95 while they last, all new....Ea.

HYDRAULIC TRANSMISSION

variable speed for use in lathes, pumps, drills, milling machines, etc. Speed can be varied from 0 to R.P.M. to 650 R.P.M. forward or reverse. At 1/4 H.P. to 1/2 H.P. input. Unit must be converted to bring reversing switch and speed control outside case. Has 5/8 H.P. 115 V. Motor mounted on unit. Complete in excellent condition.	
	\$47.50

SOUND POWER PHONES

These are the old style telephone magnetic earpiece which now can be used as sound power phones. Will work up to a few hundred feet without any external voltage source. Sound power phones never before at this low price.	
	\$1.50 PAIR

12 OR 24 VOLT VIBRATOR INVERTER

Use for mobile radio, trucks, boats, etc., where 110 Volt, 60 Cycle is desired. Can be used on 12 Volts or 24 Volts D.C., input 110 V., 60 cycle, 240 watt maximum output. Uses separate vibrator for each input voltage. In enclosed case, excellent condition.	
	\$27.50

MICA CAPACITORS

A	B	C

FIG. A UPRIGHT MOUNTINGS	
MFD.	1000 V. Ea.
.025	2500 V. Ea.
.0075	2.25
.0006	.0006
.002	.0006
.00025	.00025
.00015	.00015
.0001	.0001
.00005	.00005
.00002	.00002
.00001	.00001
.000005	.000005
.000002	.000002
.000001	.000001
.0000005	.0000005

FIG. B SCREW TERMINAL	
500 V.	1200 V.
.002	.85
.005	.85
.01	.75
.02	.75
.04	.75
.06	.75
.08	.75
.10	.75
.12	.75
.15	.75
.20	.75
.25	.75
.30	.75
.35	.75
.40	.75
.45	.75
.50	.75
.60</td	

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D. Gnessin,
Educational
Director

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 over 450 TV COMPONENTS with
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 etc. Low prices make your complete kit a terrific buy!



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Mr. D. Gnessin, Educational Director

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 Send FREE copy of your new TV Kit Catalog.

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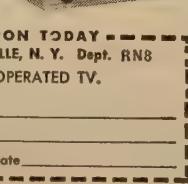
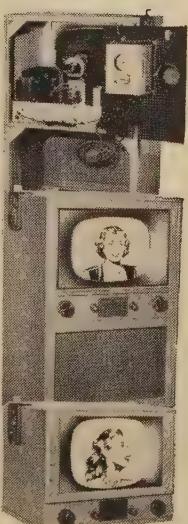
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Rush full details on COIN OPERATED TV.

Name _____

Address _____

City _____ State _____

RECTIFIERS AGAIN

BY THOMAS R. HUGHES

THIS is a further commentary on my article, "Unrecognized Hazards in Electronics," which was published in the April issue of this magazine. Since this article appeared, I have received some objections from the manufacturers of rectifiers who feel that it may have placed the use of selenium rectifiers in a bad light.

I want to assure you that I had no such intention, in fact—if anything—I meant to accomplish the opposite. Being a safety engineer and, at the same time, an experimenter in sound equipment and electronics, I was somewhat concerned over a previous article on the subject, in another publication, that included misinformation and exaggerations.

My article was aimed at electronics designers, maintenance men in factories and plants, and radio or television technicians in repair and service shops. It was not expected to apply to users of electronic equipment in the office or home, nor to workers in selenium rectifier manufacturing plants (where suitable precautions are observed).

Selenium rectifiers have provided the means for valuable progress in many fields where direct current is required. Though they are used extensively in the electronics and aircraft industries in California, we apparently have no record of serious injury as a result.

My article was not intended to cause alarm in the mind of any reader but it was my wish to call to the attention of those who deal with large rectifiers that the existence of toxic fumes is possible.

While there is little in past experience to base opinions on, I left the implication that one could dismiss the normal use of small rectifiers (in radios, television, etc.) as a source of serious hazard. However, since the uses of electronic circuits and their supply from rectifiers are invading more fields every day and we have no means of anticipating their applications or misuse, we cannot let possible hazards go unrecognized.

Thus, I went to some pains to outline the precautions that one could observe if he felt any concern over his application of a rectifier. I used the word "should" in some places and was careful not to imply that any of the precautions recommended were absolutely required.

One more point that I feel should be cleared up is what I meant by a "burn-out." I used the word "are-over" as electricians use it—to indicate that damage was caused by electricity passing over the surface of a dielectric or insulator rather than through an internal short circuit. I find that my use of the term was misinterpreted as referring to the momentary flashes frequently occurring during the first energizing of the cells in manufacture.

By a "burn-out," I was referring to the breakdown of a group of cells and the burning, by prolonged arcing or conduction of current, to chemical compounds differing from those required for normal operation. In other words, its destruction as a rectifier.

I hope this will be of value in removing any discredit my article may have brought to selenium rectifiers. In their present state of perfection they merit our high regard as simple, foolproof servants.

—30—

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designated	54th Harmonic MC	freq.	Listed by
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5 CRYSTALS,			Assorted ONLY \$2.
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COMPLETE SET!!!!!!	80 crystals covering above		
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United States! Write in for terrific buy!			

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 Factory guaranteed, includes year of
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RINE TRANSMITTER**. Putts out max power
 allowed by F.C.C. Contains all latest im-
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BC-223 25 W. MARINE TRANSMITTER & ARB-
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**JEFFERSON-TRAVIS MARINE 5' W. RADIO-
TELEPHONE**. Made by Emerson Radio Corp.
 2-channel, crystal controlled receiver &
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 standard 6V car battery. Complete with
 tubes, instructions, but less crystals and
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Above item with 110 V. charger for 6V
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CRYSTALS FOR ABOVE: Specify freq. of
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SCR-183 12 V. RECEIVER & TRANSMITTER. Complete
 aircraft, marine and ham bands! Complete with
 coils, control boxes, tuning head, flex cable, rack &
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 ual parts worth \$25.35. EXCEL. COND. COMPLET-
 Never before sold at this sensationaly... \$15.00
 low price.

ARC-5 OR 274-N TRANSMITTERS

2.1-3 mcs. Brand new	\$19.95
3-4 mcs. With tubes	8.95
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ARC-5 OR 274-N RECEIVERS

Equipped with tuning knobs	
.19-.55 kc. Brand new	\$19.95
1.8-3 mcs. Brand new	24.50
3-6 mcs. With tubes	12.50
3.6 mcs. With tubes	10.95
6-9.1 mcs. Used	7.95
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MD-7 OR 274-N PLATE MODULATOR. Excel. cond.	17.95
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12 V. COMMAND RECEIVER DYNAMO- TOR. New	12.95
Plus All Accessories Needed for Above.	

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 Write Today—and ask for FREE CATALOGUE
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Navy or Army Ordnance type 60 cycle types
 follows: \$35.00 for IDG, LD, IF, IG, IDF, ID
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 Selsys Models 2J5HAI, 2JDHAI, 2J5LAI;
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 49-7, 25-11, etc.; Delco and GE PM Motors,
 verters, Tubes, and other Electronic Compon-
 All Merchandise Subject to Inspection. See
 Lists—Will advise Price.

ELECTRO SALES CO., INC.
 Dept. RN 58 Eastern Ave. Boston,

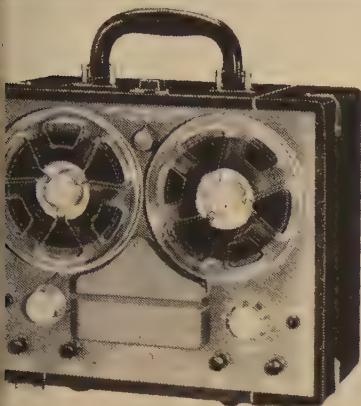
RADIO & TELEVISION

WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page and the issue number, delay will be avoided.

PORTABLE RECORDER

The Magnematic Division of Ampli-Corp. of America, 398 Broadway, New York 13, N. Y. is now offering a

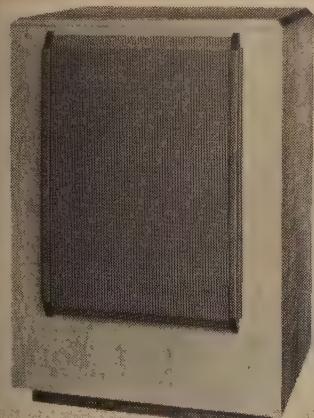


117 volt, a.c. portable tape recorder which weighs 19 pounds and has a frequency response of 50 to 10 cps at 7½ inches-per-second. Completely operated by push-button control, the new unit features a sole-operated, clutch-controlled capstan drive to start and stop tape reel within 1/20th of a second. The "Magnematic" is designed for extreme simplicity of operation; it is safely constructed to withstand the rigors of portability, and provide maximum stability and dependability of performance.

For complete technical specifications and prices write the company at.

BASS REFLEX ENCLOSURE

Ham Instruments Corporation, 350 Avenue, New York 1, New York has added two new wall and corner bass reflex loudspeaker enclosures to its line of "Tannoy" housings.



While designed to be used with the company's dual-concentric speakers, new enclosures can be used with

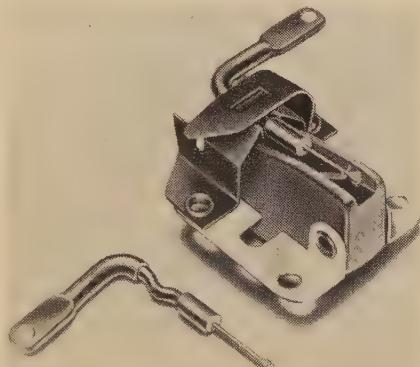
other makes of 12- and 15-inch loudspeakers. They are constructed of ¾" lumber with all joints close battened, screwed and glued. Interiors are completely insulated to absorb internal standing waves and sound reflections.

The wall-type enclosure is designated as the "Westminster," the corner-type has been named the "Parliament." The "Westminster" is 39½" high, 28" wide, and 19¾" deep. The "Parliament" is 42¾" high, 30" wide, and 20½" deep. Both styles are available on a custom basis.

TURNOVER CARTRIDGE

Sonotone Corporation of Elmsford, New York is now offering a new phonograph pickup design, the "Titone Turnover."

Using a high-compliance, high-sensitivity ceramic element and a unique turnover method, the new cartridge provides some interesting characteristics. Requiring no equalizers or pre-amplifiers, the cartridge has an out-



put of one volt and is unaffected by moisture or temperature.

The jewel needle tips (either diamonds or sapphires) are mounted back-to-back on a single shank, the entire assembly rotating for needle change. When replacement is required, the complete needle assembly, including the lever handle, is removable as a unit.

NEW UTAH BAFFLES

Utah Radio Products Co., Inc. of Huntington, Indiana has added a series of wall baffles to its line of products.

The new baffles have been trademarked "Utone" and are designed and engineered to give a maximum of clean, life-like tone. The baffles are built without a single nail, all joints being mortised and secured with waterproof glue. They are self-mounting, needing no metal brackets for installation.

They are available in four sizes for 6, 8, 10, and 12 inch speakers and

L. Veltri, busy service-dealer of Westchester, N. Y., reports:

I SAVED \$940*
by making a \$59 INVESTMENT
in a Transvision
FIELD STRENGTH METER

*Says Mr. Veltri: "... The way I figure, in the last 6 months I saved that much money in installation time alone ..."



FIELD STRENGTH METER

Saves 50% of Installation Cost
Pays for itself on 3 or 4 jobs

NO TV SET NEEDED

Works from antenna . . .

Measures actual picture signal strength directly from antenna. Shows antenna orientation maxima. Compares gain of antenna systems. Measures TVI on all channels. Checks receiver re-radiation (local oscillator). Permits one man antenna installation.



Eliminate variables, insure accuracy with direct meter readings on the FSM.

PREVENT WASTE OF SERVICING TIME! By checking antenna performance with the Field Strength Meter, the serviceman can determine whether the TV set or antenna, or both, are the source of trouble. Call backs are eliminated.



Wide range: Measures field strength from 10-50,000 microvolts. Has Fringe Area Switch for weak signal areas. 13 channel selector. Individually calibrated on every channel.

ADAPTABLE for UHF

Model **FSM-2**, for 110V AC only. Complete with tubes. Wt. 13 lbs. net \$59.

Model **FSM-3B**, for 110V AC and Battery Operation (all batteries and cables included). Wt. 22 lbs. net \$79.

Order direct from factory:

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FREE: Sample copy of "TV and Electronics Notes". Or send 50¢ for year's subscription.



10 DAY TRIAL

Buy and try this fine instrument for 10 DAYS. Then, if you wish, you may return it. Your purchase price less 10% (our cost of handling and re-packing) will be promptly refunded.

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HERE'S WHAT
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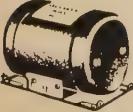
- 1 IMMEDIATE DELIVERY FROM STOCK**
(in any quantity)
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The valuable service Wells provides to the industry is being used by many of our greatest manufacturers as a matter of course.

Our vast stock (the world's largest) may contain just the components you need to fill urgent orders — at a substantial savings in time and cost.

ADEL CLAMPS • ANTENNAS, Insulators, Mast Sections • BINDING POSTS • BLOWERS • CABLE ASSEMBLIES • CHOKES • COILS • CONDENSERS Oil Filled, Bathtub, Hearing Aid, Transmitting Micas, Silver Micas, Ceramic, Variable, Trimmer • CRYSTALS • FILTERS • FUSES & MOUNTINGS • GENERATORS • GROUND RODS • HEADSETS • I.F. COILS • JACKS • JACK BOXES • KEYS, Telegraph KNOBS • LAMPS • LORD MOUNTS • LUGS MOTORS & BRUSHES • PLUGS • RECTIFIERS Selenium, Copper Oxide, Meter, Diode • RESISTORS—All Types • SELSYS • SOCKETS • SWITCHES Aircraft, Micro, Switchettes, Toggle • TIMERS • TUBING—Flexible • TUNING SHAFTS • TRANSFORMERS All Types • VIBRATORS • WALKIE TALKIES

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Large quantities of brushes for all types of dynamotors and motors.

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Manufacturers and distributors—write for new Condenser Catalog C-10 now available.

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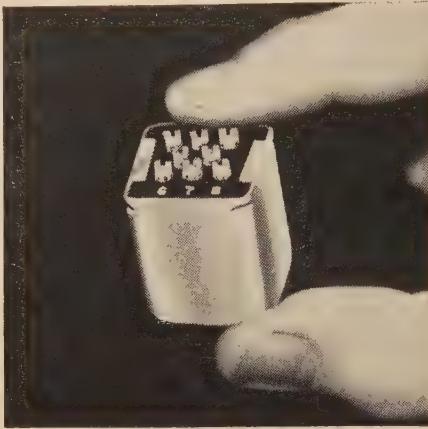
33 W. Chicago Ave., Dept. R, Chicago 22, Illinois

come in three finishes—red or brown mahogany finish and futuristic blonde finish. All sizes are also available in natural, unfinished wood.

STANCOR "TINYTRANS"

Standard Transformer Corporation, 3580 Elston Ave., Chicago 18, Ill. is now marketing a new line of miniature high-fidelity audio transformers, known as "Stancor Tinytrans."

The miniature units are made with nickel steel laminations, with a fre-



quency response of ± 1 db, 30-15,000 cps, maximum level 0 db. They are sealed and potted in $\frac{1}{8}$ " square, anodized aluminum cases with phenolic terminal boards. Total height, including terminals, is only $1\frac{1}{4}$ ". The case has two 2-56 threaded inserts, $1\frac{1}{16}$ " centers, for easy chassis mounting. It weighs only 1.3 ounces.

A bulletin on these units is available on request.

REGULATED SUPPLY

Kepco Laboratories, 131-38 Sanford Ave., Flushing 55, N. Y. has introduced the Model #400 voltage regulated power supply which features one regulated "B" supply, one regulated "C" supply, and one unregulated filament supply.

The "B" supply is continuously variable from 0-400 volts and delivers from 0-150 ma. Ripple voltage is less than 5 millivolts. The "C" supply is continuously variable from 0-150 volts and delivers from 0-5 ma. The filament supply delivers 6.3 volts at 10 amperes and is unregulated, center-tapped, and ungrounded.

The power supply is designed for relay rack mounting or bench use. The cabinet is 7" high, 19" wide, and 11" deep. The weight is 40 pounds.

SUPPORT CHANNELS

The Lowell Manufacturing Company of 3030 Laclede Station Road, St. Louis, Mo. has announced the availability of a line of steel support channels which simplify the installation of sound system speakers in suspended ceilings.

These channels are available for 24" and 48" spans and are easily installed in any standard type of suspended ceiling construction. They can be used in either new or existing ceilings.

CRYSTALS FOR ALL PURPOSES

LOW FREQ.—FT	241A for SSB, latice filter, $\frac{1}{2}$ " spc. 54th or 72nd harm channels listed by fund. Fractions omitted.	SCR-522	BC-610 2 banana plugs
370	392 412 433 494 515	400 459	2030 2390
372	393 413 434 495 516	440 461	2030 2415
374	394 414 435 496 518	441 462	6370 2445
375	395 415 436 497 519	442 463	2045 2462
376	396 416 437 498 520	443 464	2065 2532
377	397 418 438 501 522	444 465	1497 9 2125 2537
379	398 419 481 502 523	447 468	6522 9 2125 2537
380	401 420 483 503 525	450 470	6610 2145 2537
381	402 422 484 504 526	451 472	7390 2220 3250
383	403 423 485 505 527	452 473	7480 2258 3322
384	404 424 486 506 529	453 474	7580 2260 3510
385	405 425 487 507 530	454 475	7810 2282 3550
386	406 426 488 508 531	455 476	7930 2290 3580
387	407 427 490 509 533	456 477	2300 3500
388	408 429 491 511 534	458 480	2305 3545
390	409 430 492 512 536	459 481	200 or 500 KC
391	411 431 493 513 537	460 482	10 for IN FT
		514 538	9.00 241 A
			HOLDER \$1.29 EA
			$\frac{1}{2}$ " SPC. \$1.29 EA
			49¢ EA—10 for \$4.50
			99¢ each

FT 243— $\frac{1}{4}$ " P IN SP.C.

4190	6175	7806	1015	5760	5873	6340	6573	6740	6750
5030	6206	7840	3735	5773	5898	6373	6575	6740	6750
5485	6773	7873	5305	5800	5940	6406	6600	7506	7706
6040	6873	7906	5617	5806	5973	6450	6606	7540	7973
6073	7740	7940	5706	5825	6273	6473	6640	7573	8240
6140	7773		5725	5840	6306	6500	6673	6706	7873
			5740	5850	6325	6547	6706	7640	

49¢ EA—10 for \$4.50

99¢ each

10 for IN FT

9.00 241 A

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9.00 241 A

$\frac{1}{2}$ " SPC. \$1.29 EA

ecifications and information on steel support channels are available from the company on request.

PRINTED-CIRCUIT SWITCH
The Daven Company, 191 Central Avenue, Newark, N. J. now has available a new printed circuit rotary switch Type PCF-1 with 60 position, snap-type action.

Leads are provided for solder connections at every position. The Type



-2, having non-shorting positions, is also available. The switch segments are silver-alloy bonded to the phenolic contact panel. The rotor arm is the company's "knee-action" type rotor which provides uniform contact pressure and very low contact resistance throughout switch life.

Contact resistance is approximately .004 ohm and does not vary more than .0003 ohm over the life of the unit. The diameter is 3" and the height is 2 1/16".

Additional information is available through Dept. PCS of the company.

GERMANIUM DIODES

A line of nineteen point-contact germanium diodes has been announced by the transistor division of National Carbon Radio Corp. of Hatboro, Pa.

The encasing cartridge is composed of a plastic material impervious to moisture and having good electrical characteristics and mechanical stability at high temperatures. The stiff terminal pins permit clipping of the diode into spring terminals either for bench or circuit application and the flexible leads permit soldering or other suitable connection means.

In engineering bulletin, No. 1001, are electrical specifications on the eighteen new units. It is available on request.

GENERATOR ADAPTER

The Accessory Division of Philco Corporation, Allegheny & "A" Street, Philadelphia, Pa. is in production on Model G8000 v.h.f.-to-u.h.f. signal generator adapter.

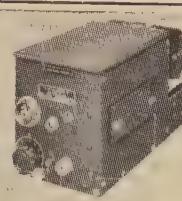
The company's u.h.f. tuner is the heart of the new adapter. It permits measurements to be made at u.h.f. while controls, markers, and attenuators are operated with the usual convenience at the common v.h.f. frequencies.

As the output from any v.h.f. signal generator at 60 mc. is fed into the



FOLLOW ARROW FOR BIGGEST STOCK AT LOWEST PRICES

- RADAR - TRANSMITTERS
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234-258 MC RECEIVER

11-tube UHF tunable receiver with schematic. Like new.

\$17.95

Rack \$3.50
Control Box. 1.50

RADAR TEST EQUIPMENT

TS-3, TS-12, TS-13, TS-15, TS-23, TS-34, TS-35, TS-36, TS-45APMS.

→ → → FOLLOW ARROW TO GET HIGHEST PRICES FOR YOUR NEW AND USED RADIO GEAR! What have you to sell? WRITE TODAY!



UHF Transmitter

450-710 MC. Tunable UHF Transmitter. 10 W. output. Two 368-type tubes used. Push-pull oscillators. Width 8 1/4" x 10" x 12". Amplifier. Less tubes. With schematic. Excellent condition. **\$8.95**



R.F. Modulator

Complete Tunable 205 MC. Test Set. With 110 V. 60 cps. power supply, 3-stage audio amplifier. Terrific chassis for experimentation. With schematic. Like new. **\$9.95**



INTERPHONE AMPLIFIER

BC-709-B
A 2-position single stage audio amplifier. Uses 1 tube and operates from self-contained batteries. With Instruction Manual and Schematic. **\$3.95**
NEW (less batteries).....

ARC-4 TRANSCEIVER

140-144 MC. Complete with control box, tubes, 12/24 VDC dynamotor with schematic. This is a special reduction for this month only. **\$32.50**
Like new
MT 101 ARC-4. Rack. **\$6.00**

COMMAND EQUIPMENT (SCR-274N)

	Used	New
BC-442 ANTENNA RELAY. Less cond.	\$1.95	
BC-451 WIRELESS		3.95
BC-452 TRANSMITTER CONTROL BOX		1.50
BC-450 3-RECEIVER REMOTE CONTROL BOX		2.95
MC-215 MECHANICAL DRIVE SHAFT. Per length		2.95
BC-496 2-POSITION RECEIVER CONTROL BOX		2.95
BC-455 6-9 MC RECEIVER. With tubes	9.95	14.95
BC-454 (3-6 MC) With tubes		9.95

	Used	New
BC-453 With tubes	\$19.95	
MC-211 90° ANGLE COUPLING UNIT.		\$.95
FT-234 MOUNTING RACK for single transmitter		2.95
FT-226 MOUNTING RACK for 2 Command Xtrs.		3.95
FT-221 MOUNTING PLATE for FT-220 receivers		1.50
FT-222 MOUNTING RACK for 3 receivers		2.25
FT-225 MOUNTING PLATE for BC-456		2.25
BC-456 MODULATOR. For SCR-274..		4.50
Complete set of 4 tubes for transmitter		1.25



Miscellaneous Specials!

H-16 / V HEADSET. 8,000 ohms.....	\$3.95
HS-18 HEADSET. New	2.45
HS-23 HEADSET. High imp. New	4.95
HS-30 HEADSET. Featherweight type. Low imp. NEW	2.49
HS-33 HEADSET. Low imp. New	6.95
HS-38 HEADSET. USED, excel cond	1.49
NEW	3.50
T-32 DESK STAND MIKE. New	5.95
LIP MIKE. Navy type. New98

SURPRISE PACKAGE!
20 lbs. of good, useable radio parts **\$2.95**

TUBES!	TUBES!	TUBES!	TUBES!
16JP4 .. \$19.95	304TH .. \$8.95	5CP1 .. \$4.95	3FP7 .. \$2.25
16AP4 .. 24.95	304TL .. \$8.95	5BP4 .. 4.95	9002 .. 1.65
16DP4 .. 19.95	830-B .. 2.75	5FP7 .. 2.25	9001 .. 1.65

TUBES!	TUBES!	TUBES!	TUBES!
PE-125 POWER SUPPLY. Operates on 12 or 24 v. battery. NEW	\$17.95		
CD-307 EXTENSION CORD. For HS-23-33. NEW95		
RS-38 MIKE. NEW	4.95		
SCR-625 MINE DETECTOR. New	59.50		
BC-605 INTERPHONE AMPLIFIER. With dual mike input circuit. NEW	5.95		
TELEPHONE REPEATER AMPLIFIERS:			
EE-99, New, with tubes	17.95		
EE-89, New	12.95		
FL-R RANGE FILTER.	1.95		

MP-22 MOBILE ANTENNA. MOUNTING RACK. Comp. with hardware. Per Pair	\$4.95	Ea.	\$2.95
TU-17 TUNING UNIT. (2-3 MC.) For BC-223 Xmt. Used	2.95		
I-70 "S" TUNING METER. NEW	2.50		
WIGGULATOR. See p. 43. Dec. '51. RADIO NEWS	5.95		
BC-1023 75 MC. MARKER BEACON RECEIVER. Complete with tubes, mng. rack. NEW	10.95		
TU-25 TUNING UNIT. (3.5-5.2 MC.) For BC-223 Xmt. Used	2.95		

IN-4A L/R TUNING METER. Used	\$3.95		
FL-5 RANGE FILTER.	1.25		
TU-10 SWING POWERED HAND SET-Used, exc. cond.	14.50		
PE-55 DYNAMOTOR 12' V input. 500 VDC @ 200 mils output. New	24.50		
FIELD TELEPHONE. EE-8. Complete BRAND NEW. SPECIAL. ONLY	27.50		

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We carry one of the most complete stocks in U. S. of Military Electronic Equipment, Test Equipment, and Aircraft Electronics. Call or write for free catalogue.

250 TL TUBES—Limited Quantity!
Only \$9.50 each
Save \$2.00! Order 2 for only \$17.00

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EQUIPMENT WANTED! Highest prices paid for all types of Electronic Gear!

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4 for 53 NEW

Trav-Electric CONVERTERS

CHANGE 6 OR 12 VOLT D.C. TO
110 VOLT A.C. 60 CYCLE
Just plug into Cigar Lighter on Dash.



Trav-Electric Super
Model 6-71160
60 cycle
60-75 Watts
\$37.95 LIST

Size 4" x 5" x 6"
Operates

- Wire Recorders
- Dictating Machines
- Amplifiers
- Turntables
- Soldering Iron
- Small Electric Drill



Trav-Electric Master
Model 6-51160
60 cycle
40-50 Watts
\$24.95 LIST

Size 4" x 5" x 6"

Operates

- Curling Irons
- Radios
- Turntables
- Small Dictating Machines
- Test Equipment, etc.
- Portable Phonographs



Trav-Electric Senior
Model 6-11160
60 cycle
35-40 Watts
\$15.95 LIST

Size 2 1/2" x 2 1/2" x 4 1/2"

Operates

- Test Equipment
- Turntables
- Lights
- Short, Long Wave Radios
- Portable Phonographs
- Electric Shavers, etc.



Trav-Electric Midget
Model 6-11160
60 cycle
10-15 Watts
\$11.95 LIST

Size 2" x 2" x 3 1/2"

Operates Test Equipment, All Electric Shavers

Fully Guaranteed

See Your Jobber or Dealer

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Export Sales Division: Scheel International, Inc.

4237 N. Lincoln Ave., Chicago 18, Ill., U. S. A.

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adapter, the v.h.f. sweep or marker signal beats against the u.h.f. oscillator of the unit, producing u.h.f. signals having the same characteristics as the v.h.f. input signal.

The company will supply full details on this and other units in its test equipment line on request.

TV BOOSTER

Electro-Voice, Inc. of Buchanan, Michigan is now offering a new, improved Model 3012-A, 3-tube automatic, all-channel television booster, for v.h.f. applications.

A new low-noise, broadband circuit



multiplies the signal at the antenna. Three tubes in balanced stages, including a power multiplier stage, are used to provide adequate gain for producing clear, sharp signals.

The booster unit is housed in a weather-resistant case which mounts on the antenna mast. The junction box plugs in between the receiver and an a.c. outlet. Input and output are to 300-ohm balanced line.

Bulletin No. 182, available from the company, describes the Model 3012-A in detail.

LEAD-IN WALL PLATE

A new television lead-in wall plate socket that requires no wall opening or outlet box has been announced by *Mosley Electronics, Inc.* of 8622 St. Charles Rock Road, St. Louis 14, Mo.

The new socket mounts flush on the wall or baseboard and may be installed in seconds with a screwdriver. Designated as the F-2, the new unit was designed to meet the need for plug-in convenience. The socket is available in brown or ivory molded polystyrene and is supplied with mounting wood screws. It is also available packaged with one mating constant-impedance solderless plug.

Write the company direct for additional information.

TUBE SALVAGE

Kahle Engineering Co. of 1307 Seventh Ave., North Bergen, N. J. has developed and is manufacturing a combination neck cutting and neck splicing machine that will salvage larger size cathode-ray picture tubes.

Rejected tubes in 24", 27", 30", 33",

and larger sizes can be easily and rapidly returned to the assembly line as all operations are performed with one handling of the bulb.

The Model 2185 is a single head machine that takes all standard sizes and shapes of tubes. The neck cutting operation is performed by the hot-chill method, producing a clean, square cut. The cut-off mechanism is adjustable up and down. Neck tubing can also be cut.

The company will supply complete specifications and performance data on this unit to manufacturers writing the firm direct.

TUBULAR TWIN-LEAD

A new tubular twin-lead for u.h.f., designed so that attenuation is negligible under all weather conditions, has been announced by *Plastoid Corporation* of 42-61 24th St., Long Island City 1, New York.

Known as "Synkote Ultratube", the new transmission line has the leads spaced several millimeters within the tube, equidistant from the outer insulation. Thus the magnetic field between them is unaffected by any moisture or spray which may condense on the outer covering and the signal strength is maintained at a maximum all the way down to the receiver.

The new twin-lead can be used not only for u.h.f. but for peak transmission of v.h.f. signals in stormy weather, in fringe areas, and in sea-coast areas where moisture and salt spray are factors.

NON-CORNER HORN

A non-corner horn, trademarked "The Purest", has been recently introduced by *Gately Development Laboratory*, Barrington, N. J.

The unit is a new type baffle employing a horn load on the back side of the speaker it encloses for improved low-frequency response, at the same time permitting direct radiation of high frequencies. The enclosure is designed for use along any wall and does not rely on the walls of the room to act as an extension of the horn. The unit gains adequate horn mouth.



area by exhausting on three sides of the enclosure. Total fold of the horn is 180 degrees.

"The Purest" is available for 12 c

h speaker systems. Standard models are dark mahogany, blonde, natural mahogany. It is also available unfinished for those who desire to do their own finishing. Over-all dimensions are 38" high, 28" wide, and 17" deep. Technical literature is available on request.

CUSTOM SOUND ENSEMBLE™

General Electric Company has announced additions to its line of sound products which will be marketed under the name "Custom Sound Ensemble".

The ensemble consists of a preamplifier control unit, a 10-watt amplifier



and a dual coaxial speaker. A speed record changer equipped with the company's variable reluctance cartridge is used with the unit for demonstration purposes. The units are so designed as to make them adaptable to either custom installation or as separate furniture pieces.

All details on all of the units comprising the new line are available through G-E dealers and distributors.

24-INCH TUBE

Hytron of Salem, Massachusetts has recently added the Type 24 to its line of television picture

This 24-inch rectangular, 90 degree, bass, magnetically-focused picture tube provides an effective screen area of 370 square inches. It features illuminated screen for increased brightness, spherical filter-glass face, single ion-trap gun design, and external conductive coating which acts as a filter condenser.

Performance and engineering data for the Type 24TP4 are available on request.

HI-FI COMPONENT LINE

The Engineering Products Department of Radio Corporation of America recently introduced its initial line of high-fidelity sound reproduction system components.

Though the new components will be marketed individually to preserve flexibility and freedom of choice demanded by most hi-fi enthusiasts, characteristics are carefully matched to insure maximum performance in the system.

It will around the "Olson speaker", which will include a deluxe three-dimensional automatic record changer, two FM tuners (one a deluxe instru-

SEE LEO FIRST FOR . . .

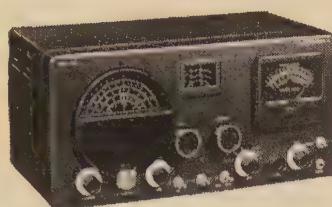
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SEE US FIRST FOR THE NEW SX-88 RECEIVER!



\$179.50

S-76 RECEIVER

Extra selectivity with double superheterodyne circuit. One RF, two conversion and 3 IF stages. Range 550-1550 Kc, 1.7-34 Mc in four bands. 8 tubes plus voltage regulator and rectifier. Complete with tubes; less speaker.



\$224.50

SX-71 RECEIVER

Double Conversion sharp selectivity, plus built-in NBFM at moderate cost. 11 tubes plus voltage regulator and rectifier. Low down payment.

NAME YOUR TERMS • LOW DOWN PAYMENTS • PERSONALIZED SERVICE

HALLICRAFTERS RECEIVERS AVAILABLE FOR IMMEDIATE SHIPMENT

S-81	\$49.50	S-40B	\$119.95	ST-83	\$129.95
S-82	\$49.50	S-53A	\$89.95	S-78A	\$89.50
A-84	\$99.50	S-72L	\$119.95	ST-62	\$299.50
S-38C	\$49.50	S-77A	\$119.95	S-72 Portable	\$109.95

R-46 Speaker \$19.95

NEW 100 WATT HT-20 XMTR-\$449.50

Famous WRL RADIO REFERENCE MAP 25¢



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NEW LOG BOOK 25¢

For mobile or fixed station. Spiral binding. Full column log listing all FCC required info. Will accommodate 1,525 stations. "Q" signals, phonetic alphabet, amateur international prefixes.

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SAVE UP TO 60% ON PICTURE TUBES

Add To Your Profit By Letting
NATIONAL Rebuild Your Duds

LOOK AT THESE
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PRICES

Exchange old tubes direct with the factory and double your profits on tube replacements. Our new process gives you a tube with a new phosphor screen, new inside-dag, new electron gun. Exhausted to highest standards. All tubes meter and set tested. EVERY TUBE CARRIES A 1-YEAR NEW TUBE WARRANTY.

How To Order

Send old tubes direct to National, together with check or money order for quantity desired at prices quoted here. We ship you new tubes immediately. All tubes sold F.O.B. Blue Springs, Mo., but we pay incoming freight on tubes shipped to us in quantities of 5 or more.

Over 17-inch to
21-INCH TUBES

18.85

Plus 10% Fed. Excise Tax
Up to and Including
17-INCH TUBES

14.85

Plus 10% Fed. Excise Tax

National Picture Tube, Inc., Blue Springs, Mo.

BC-645 TRANSMITTER-RECEIVER



BRAND NEW

\$49.50

each

15 Tubes 435 To 500 MC
Set can be modified to use for 2-way communications, voice or code, on following bands; ham band 420-450 mc., citizens radio 460-470 mc., fixed and mobile 450-460 mc., television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4-777, 4-7H7, 2-7EE, 2-6F8, 2-955, and 1-WL-216A. New! Price \$50 to \$90 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs.

CONVERSION DIAGRAM INCLUDED!

PE-101C DYNAMOTOR for above BC-645.....

\$4.85

UHF ANTENNA ASSY, for above BC-645.....

\$2.45

SCR-274N COMMAND & ARC-5 EQUIPMENT

Type	Excellent USED	BRAND NEW
BC-453 Rcvr. 190-550 Kc.	\$28.50	\$44.50
BC-454 Rcvr. 3-6 Mc.	12.50	24.95
BC-455 Rcvr. 6-9 Mc.	12.95	17.95
Rcvr. 1-3 Mc.	2.75	34.95
BC-456 Modulator	18.50	29.50
BC-457 Xmr. 4-5.3 Mc.	9.75	37.50
BC-458 Xmr. 5.3-7 Mc.	19.95	24.50
BC-459 Rcvr. control box	1.25	2.45
BC-461 Xmr. control box	1.25	1.95
3 Receiver rack	1.79	2.95
2 Transmitter rack	1.59	3.25
Single Transmitter rack	3.25	

ARC-5/R28 RECEIVER. 10 tube superhet. 100-156 Mc. Incl. tubes.....\$27.95

ARC-5/T23 TRANSMITTER. Companion for above. Brand new.....\$59.50

SELSYN 2J1G1



Operates from 57½ V.
100 Cycles. Suggested wiring for 100 V. 60 cycle included.
New, tested
Price each **\$4.50**

BEACON RECEIVER BC-1206C

Receives A-N beam signals. Tunes 195 to 420 Kc. 4x4x6½". Wt. 4 Lbs. Complete with 5 tubes. Brand new.....**\$13.50**

Same as above. Used excellent.....**\$8.95**

HEADSETS

	Excellent USED	BRAND NEW
HS-23 high impedance	\$2.95	\$4.75
HS-33 low impedance	2.45	5.75
HS-30 low imp. (featherweight)	1.49	2.45
H-16/U high imp. (2 units)	4.95	
CD-307A cords, with PL55 plug and JK26 jack, 8' long	1.19	

DYNAMOTORS

TYPE	INPUT	OUTPUT	Excellent USED	BRAND NEW
PE-86	.28	250 @ .06	\$2.95	\$5.50
DM-28	.28	224 @ .07	3.50	5.95
PE-101C	1.24	400 @ .06	1.45	2.85
PE-103	6.12	500 @ .16	22.50	34.00
PE-94	28	300 @ .2	4.95	7.95
DM-32	28	250 @ .06	2.50	6.50
DM-21	14	235 @ .09	16.50	
BD-77	12	1000 @ .35	29.50	

MICROPHONES

	Excellent USED	BRAND NEW
T-45 Lip Mike, navy type.....	\$.49	\$1.45
T-30 Throat Mike.....	.49	.85
T-32 Desk Stand Mike.....		4.95

MODULATED BC-221-AK FREQUENCY METER

BRAND NEW.....**\$210.00**

BC-221 (Non-modulated) Reconditioned, PERFECT! Complete with tubes and crystal. **\$129.50**

Lots of 3. ea. \$10.95. Single lots..... \$11.95

Please include 25% deposit with order—balance C.O.D. All shipments F.O.B. our warehouse N.Y.C.

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MINIMUM ORDER \$3.00

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MINIMUM ORDER \$3.00

Within the Industry
(Continued from page 26)

its net worth in 1953 was \$41,000 and its original six employees increased to 10,000. Sales increased from \$63,000 in 1928 to \$168,000 in 1952. The company operates plants in Chicago, Quincy, Dix, New York, Philadelphia, Detroit and Toronto for an aggregate of 10,000 square feet of space.

* * *

H. R. SHIELDS has been named to newly-created post of product manager of television picture tubes for Sylvania Electric Products



joined the commercial engineering department of the company's tube division in 1948 as a senior engineer. He joined the merchandising department in 1950, assuming supervision of test equipment products. In following year he was given an additional responsibility as supervisor of distributor sales engineering, which tried a nationwide program of special projects and meetings. In October 1952 he was appointed merchandising supervisor, television picture tubes, headquarters at Seneca Falls,

* * *

HYTRON has purchased a 42,000 square foot plant in Lowell, Mass., which will be used to manufacture transistors and germanium diodes. Current plans call for the employment up to 1000 people, but the company has taken an option on adjoining property for future expansion . . .

SPIRLING PRODUCTS CO., INC. has built a new plant at Hicksville, Long Island which will enable the firm to increase production of its line of indoor and outdoor TV antennas. The new address is P. O. Box 411, Hicksville . . .

TRITON MANUFACTURING AND DEVELOPMENT CO. has moved into a new permanent plant at 401 Grand St. in Brooklyn, N. Y. The company specializes in the machining of plastics for electronic, electrical, aircraft, etc. industries . . .

The Statistical Department of **RADIO-TELEVISION MANUFACTURERS ASSOCIATION** has moved to and enlarged quarters in Room 1404 Bond Building, 1404 New York Avenue, N. W., Washington 5, D. C.

ERIE RESISTOR CORPORATION of Pa. is building a new plant for the manufacture of electronic and plastic products at Holly Springs, Mississippi, miles south of Memphis, Tenn. . .

MARINSON RADIO CORPORATION has moved its Jamaica Branch from 172-144-24 Hillside Avenue in Jamaica to provide larger warehouse and sales facilities for its Queens and Long Island customers. The new location assures convenient drive-in shipping

last, 1953



"Boy... Have I Got the Lines!"

You, too, can have the lines—that meet your exact leadline conditions—whether you are a TV Set Dealer or Service Organization making the finest television reception installations, or a TV fan that demands sharp, "SNOW-FREE" pictures.

We specialize in the manufacture of television transmission lines—built with only one idea in mind: "THE FINEST TELEVISION RECEPTION!"

For UHF and VHF

"SHEATH-LEED"—the all-weather leadline for the toughest conditions: Salt spray in coastal areas; hot, humid weather, or for frosty, icy, wintry wind-whipping conditions which impose a severe tax . . . Pure Polyethylene Tubing encasing Standard GOODLINE AIRLEAD.



"GOODLINE" AIRLEAD—standard of leadline excellence—with 80% of the loss producing web removed. Correct impedance for sharp, "snow-free" pictures. Of pure polyethylene with flexible stranded copper-clad conductors. MANY IMPORTANT FEATURES.

NEW FULL-WEB "SHEATH-LEED"—the pure polyethylene of "SHEATH-LEED" and full characteristics of GOODLINE AIRLEAD—but NO PERFORATED WEB. No 20 (7 strand 28) copperweld wire in pure electronic golden clear polyethylene—with a pure silver-gray polyethylene sheath overall—for Maximum Weather Protection.

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Get samples "in your hands"
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RCA Type No. 208T2 Vertical Blocking OSC 4:2:1 Potted, each **\$1.20** Lots of 3, **99¢**

RCA 70° Yoke 209D1, Wired, **\$2.95**

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AUTOBOOSTER

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Model IT-75A. Originally sold for \$26.43. Now available, while quantities last, at less than manufacturer's cost. Completely automatic operation—turns on or off and is tuned by the TV receiver. For all sets drawing up to 450 watts. With 1-6AK5 and 1-6CB6 tubes. Brown hammette case. Shpg wt., 6 lbs. 90G171. Special Price. 8.95

90G171. Special Price. 8.95

★ BRUSH MICROPHONE

While They Last! \$5.95

Originally sold for \$8.61! Response, 50 to 6,000 cycles. Output level, -53 db. High impedance. Has $\frac{3}{8}$ "-27 thread. Brown. Wt., $1\frac{1}{2}$ lbs. 54G350. Special Price. 5.95

**FAMOUS NAME
MIDGET CONTROLS**

10 of one type.. ONLY \$1.75

Save while quantities last! Flat 2" shaft with all fittings and hardware. All are linear taper except "audio" and "series" on cathode. Wt., per 10, 1 lb.

No.	Ohms	No.	Ohms	No.	Ohms
U-12	5,000*	U-33	50,000*	U-46	250,000
U-14	5,000	U-34	50,000†	U-48	500,000*
U-18	10,000*	U-35	50,000	U-50	500,000
U-19	10,000†	U-36	75,000*	U-51	750,000*
U-20	10,000	U-39	100,000*	U-53	1 Meg*
U-21	15,000*	U-40	100,000†	U-54	1 Meg
U-22	15,000†	U-41	100,000	U-55	2 Meg
U-24	20,000*	U-42	150,000*	U-56	2 Meg
U-26	20,000	U-43	200,000	U-57	3 Meg*
U-28	25,000†	U-44	250,000*	U-59	3 Meg
U-29	25,000	U-45	250,000†	U-65	5 Meg*

TAPPED MIDGET CONTROLS

No.	Ohms	Tap	No.	Ohms	Tap
UT-420	250,000	50,000	UT-443	1 Meg	450,000
UT-425	350,000	70,000	UT-448	2 Meg	250,000
UT-427	500,000	100,000	UT-450	2 Meg	125,000
UT-429	500,000	50,000	UT-451	2 Meg	900,000
UT-431	500,000	225,000	UT-454	2 Meg	400,000

Newark Specials



2 Mfd. 600 VDC. General Electric Pyranol-filled capacitor Flange type mounting. Ceramic pillar terminals, 10/32" studs. Size, 2x2 $\frac{3}{4}$ x1". Wt., 1 lb 54G006. 10 for 3.00. Each 39c

5 Mfd. 1000 VDC. Type BAR. Oil filled. Solder terminals. Size, 3 $\frac{3}{4}$ x3 $\frac{3}{4}$ x1 $\frac{1}{4}$ ". Wt., 1 lb 54G400. 10 for 7.50. Each 98c

1 Mfd. 5000 VDC. General Electric Pyranol-filled filter capacitor Large ceramic terminals. With mtg. clamps. Size, 4 $\frac{1}{2}$ x3 $\frac{3}{4}$ x4 $\frac{1}{8}$ ". Wt., 3 lbs. 54G004. Special Price. 4.95

35 ohm, 50-watt Pot. Ohmite Type "J" wire-wound pot. Heavy ceramic form, $\frac{1}{4}$ " shaft for $\frac{3}{8}$ " mtg hole. 1 lb 54G587. 10 for 5.50. Each 67c

Thordarson T-45166 Output Transformer. Single 6L6 to 2-4-8-500 ohms voice coil. Case size 2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x3" high. Shpg. wt., 5 lbs. 54G581. 10 for 12.00. Each 1.50

Driver Transformer. P.P. 2A3's to grids. Case size, 3 $\frac{1}{4}$ x2 $\frac{1}{2}$ x3" high. Shpg. wt., 5 lbs. 54G111. 10 for 15.00. Each 1.95

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and receiving platforms and 5000 square feet of service area on a single floor . . .

GATES RADIO COMPANY of Quincy, Illinois has opened a new and larger office in New York City at 51 E. 42nd Street, across the street from the Airlines Terminal Building . . .

CBS-COLUMBIA INC. has moved its administrative offices from its Brooklyn plant to its new Long Island City plant at 3400 47th Avenue . . .

A second plant has been opened by **HEPPNER MANUFACTURING CO.** Round Lake, Ill.

manufacturer of television components.

The new plant at Mendota, Ill. will be devoted exclusively to the manufacture of ferrite rod antennas and flyback transformers . . . **GENERAL ELECTRIC COMPANY** has opened a new tube warehouse at 3800 N. Milwaukee Ave. in Chicago. The structure provides almost 100,000 square feet of floor space and will serve as headquarters for the company's central regional sales organization for electronic tubes . . .

PHILCO CORPORATION OF CANADA is erecting a modern, 80,000 square foot plant at Don's Mills, a Toronto suburb, which will be devoted to the manufacture of television receivers, radios, and other electronic equipment. The plant is expected to be ready for occupancy early in 1954. The company is currently operating in rented quarters in Toronto . . .

RAYTHEON MANUFACTURING COMPANY has started a \$1,750,000 modernization program at the former Lowell (Mass.) Ordnance plant. The plant was occupied last November by the company and the modernization program is being carried out while the plant is in production . . .

SYLVANIA ELECTRIC PRODUCTS INC. has announced plans for a new 416,000 square foot television set manufacturing plant to be built in Batavia, N. Y. The plant is expected to be completed by Feb. 1, 1954.



RAYMOND C. COSGROVE has been elected to the post of chairman of the board of the *National Company*, succeeding William A. Ready who re-tired recently.

Mr. Cosgrove was formerly executive vice-president of *Avco Manufacturing Corp.* and president of Radio Television Manufacturers Association.

Mr. Ready is the oldest official of an electronic manufacturing firm still active in the ARRL. He has been an official of the company for 38 years and until March of this year served as president and chairman of the board.

E. F. JOHNSON COMPANY of Waseca, Minn. has purchased the inventory, tools, dies, and rights to manufacture the *Signal* line of telegraph instruments and keys. The line was formerly manufactured by **SIGNAL ELECTRIC MANUFACTURING COMPANY** of Menominee, Mich. . . . A new organiza-

tion for the development and manufacture of electronic equipment has been formed under the name of **AMPEX TRONIX INC.** at 280 Ninth Ave., New York 1, N. Y. Products include multiwaveform generators, projectors, scopes, electronic timers, and oscilloscope calibrators.

* * *

THE WESTERN ELECTRONIC SHOW

ninth annual meet will open Aug. 19th at the Civic Auditorium in San Francisco for a three-day run.

Almost 80 per cent of the electron manufacturers of this country will occupy 327 booths to display products used in broadcasting, communications, telemetry, servicing and installation accessories, etc.

The trade show is closed to the general public and no home receivers or other strictly consumer items will be displayed.

Four technical sessions daily will be sponsored by the (7th Region) Institute of Radio Engineers.

ATLANTA HAMFEST

THE Atlanta Radio Club, Inc., will hold its annual Hamfest on August 30th at Robinson's Tropical Gardens near Atlanta, Georgia. The menu will include fried chicken and free drinks, and the program features games and activities for YL's and XYL's as well as contests and a transmitter hunt for the men.

Admission will be \$3.00 for adults, \$1.75 for children. Reservations and further information can be had from R. Warren, W4RVH, 490 Angier Ave. N.E. (Apt. #3), Atlanta, Georgia.

MARS CD PLANS

BY JOINT agreement the Department of Army and the Department of Air Force have issued the policy indicated below to military commanders in the interest of providing guidance relating to civil defense planning.

"Within the scope and mission of the MARS program as approved and published, the use of MARS facilities as a military communications asset in support of Civil Defense will be governed by these policies. Within the current availability of personnel and equipment MARS may:

a. Make available communication services between the military forces in support of civil defense and the civil defense agencies.

b. Make available communication services for civil defense forces on temporary or emergency basis where such services are not otherwise available.

c. Make available radio terminal facilities at designated military installations for civil defense tie-in as required.

d. Make these services available on military frequencies assigned to established MARS networks."

The military requirement for MARS and the availability of personnel, equipment, and frequencies during periods of national emergency will govern the extent to which MARS services can be made available to Civil Defense agencies.

A survey will be conducted by MARS in order to determine those civil members who will be qualified and willing to participate in this communications support mission.

Home Security Radio Continued from page 62)

ately 10 microvolts-per-meter. Second series of trials was next to compare the sensitivity of the receivers when situated in unfavorable reception locations. In this test 10 watt and less stations in a one mile radius were recorded without coupling according to power. The number of these stations which could be heard by each of the three sets was determined and the per-cent received was calculated. This pattern allowed for three locations: an at the ground site, a householder's site and a "bomb shelter."

A-2 receiver, when set up in the culvert was provided with 20 feet of vertical antenna one and one-half feet below grade. The "bomb shelter" culvert 33 feet long, 18 feet wide 7½ feet high, open at each end overlaid by reinforced concrete a secondary roadbed. The horizontal antenna of the security receiver was positioned in the center of the culvert and perpendicular to its long axis. The three sites were geographically less than half mile apart.

Comparative sensitivity of two receivers in the three locations shown in Fig. 4B. The security receiver is superior to the commercial portable at two sites but at

the third, the "bomb shelter," they appear as equal. Lack of apparent superiority of the A-2 receiver in the shelter site may be explained by the fact that there was no signal of intermediate strength. The culvert attenuated weak surface signals to a nondetectable level while strong original signals penetrated the culvert sufficiently to be heard by both receivers.

Immediately following an enemy attack on a large metropolitan area, each surviving household would require vital information and instruction to forestall panic. Instruction could be broadcast, lacking telephone and metropolitan broadcast service, by utilizing a sensitive battery-operated receiver tuned to a transmitter located in a neighboring community. A home security receiver designed for this purpose and operating from a single No. 6 dry cell is described. The sensitivity of this receiver assayed at ground level, in a cellar, and in a simulated bomb shelter was superior to a commercial four-tube portable vacation radio but less than that of a commercial communications receiver.

REFERENCES

¹ Caldwell, John M.; Ranson, Stephen W.; Sacks, Jerome G.: "Group Panic and Other Mass Disruptive Reactions," U. S. Armed Forces Medical Journal, April 1951.

² Schmidberg, W.: "Treatment of panic in casualty area and clearing station," Life and Letters Today, Autumn 1939.

³ Passow, E. B.: "Preselection in Inexpensive Broadcast Receivers," Electronics, September 1941.

-30-



This all-purpose case is ideal for housing meters, controls and switches of all types. Made of heavy molded black plastic with matching phenolic panel. Easy to drill and saw. Available in two sizes; 5-1/4" x 6-7/8" x 2-5/16" 3-3/4" x 6-1/4" x 2"

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In commemoration of twenty-five years' experience in the manufacture and development of high-fidelity audio equipment, Espey is proud to present its distinguished "Trophy" models. Renowned for beauty of styling and excellence of performance, the new Espey models are so reasonably priced that for the first time magnificent listening pleasure is within the means of all lovers of fine audio reproduction.

Descriptive literature on the new Espey AM-FM chassis, tuners and amplifiers is now available . . . your inquiry is invited.

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WORLD'S LARGEST MANUFACTURER
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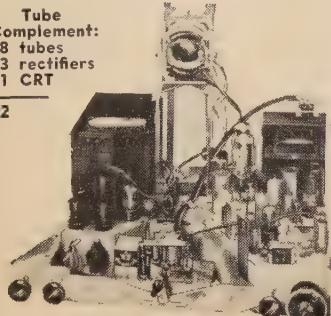
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BUILT-IN BOOSTER
for Better DX Reception

Featuring NEW CASCODE TUNER
made for UHF interchangeable
tuning strips and 70° COSINE YOKE

Tube
Complement:
28 tubes
3 rectifiers
1 CRT

32



All Channel Booster

Broad band single knob control pre-amplifier built in to eliminate long leads which may cause regeneration and attenuation of signal.
ONLY THE MATTISON 630 CHASSIS HAS AN ALL CHANNEL TUNEABLE BUILT-IN BOOSTER THAT INCREASES SIGNAL STRENGTH UP TO 10 TIMES. THE SILVER ROCKET WILL OUT-PERFORM ANY CHASSIS MADE AND IS PRICED RIGHT TO SELL FAST WITH AN EXTRAORDINARY MARGIN OF PROFIT FOR YOU. WRITE FOR CONFIDENTIAL PRICE SCHEDULE.

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The only open face console made in every expensive decorator finish . . . on guaranteed genuine mahogany, walnut, oak and other rare woods!



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Best Looking . . . Best Value, Too!
Full size console for eye level television. Available in every expensive decorator finish. Featuring removable safety glass. Dimensions height 42 inches, width 26 inches, depth 23 inches.

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Manufactured with integrity
Mattison Television & Radio Corp.
10 West 18th St., Dept.RN, N.Y.53, N.Y.

Electronics for Yachtsmen (Continued from page 67)

The radio direction finder has begun to find acceptance among small boat owners in recent years. Basically, it is a sensitive radio receiver with a very directional loop antenna which can be rotated on a compass-calibrated base. When beamed on known signal sources, generally RDF (radio direction finder) stations or charted broadcast stations, the boat's position can be established. Once this point is known, it is plotted on the chart and the new compass bearing determined. From there on it is a simple matter to hit the destination "on the nose."

While these are the only really important items needed aboard small craft, there are other pieces of electronic gear that contribute to the safety of the boat and the peace of mind of the captain. Moderate cost radio depth finders (fathometers) are now available and are being enthusiastically accepted by yachtsmen who cruise outside of charted areas. The instrument gives an indication of the depth of the water based on half the time it takes the signal to be transmitted from the boat to the bottom and return, with some allowance being made for mud penetration. In addition to preventing accidental grounding of the boat on hidden reefs, the fathometer is being used extensively to locate schools of fish whose massed bodies reflect the sound waves in the same way that the sea bottom does. Like the direction finder, the depth finder can be used to advantage in fogs and other closed-down conditions. By comparing depth readings from the graph with depth readings on the navigation charts, a fairly educated "guess" as to location can be made.

Since many small boats do not have the battery capacity to operate all this equipment for any extended period of time, extra generators (run from the motors), extra batteries (if possible), and shoreline battery chargers and eliminators are essential. Batteries can be recharged either at the boat's destination or in its home port. Power lines are run to the boat when in port and the charging handled there.

In addition to the safety radio equipment aboard a boat, many owners are adding such purely pleasure gear as television receivers and small portable radios. Television lends itself particularly well to use in close quarters and provides ready-made entertainment when in strange ports. Because of the load, it isn't practical to run the television receiver from the boat's battery supply but in port where it can be operated from power lines it is a real addition to the basic equipment. The requisite a.c. is available at most commercial and yacht club piers.

The boat, "Miss Eico", shown on

RADIO & TV TUBES

70 to 90% Off List

YOUR INQUIRIES INVITED ON SPECIAL PURPOSE AND TRANSMITTING TYPES
CONDENSERS

20-20—150V. 10 for \$2.95
40-40—150V. 10 for \$3.25
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HEAD PHONES

5 ft. moisture proof cord and phone tip terminals. 600 OHMS. Now only \$2.98 each per set.

TUBE REJUVENATORS

Increases the life of fading picture tubes \$1.63 each.

RESISTORS

Sold only in assorted lots of 200 for the low, low price of \$1.98. Not insulated.

Hi-Lite Electronic Sales Co.

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RCA INSTITUTES, INC.



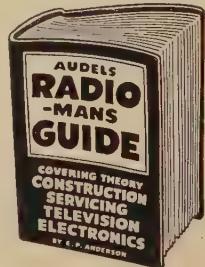
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RADIO & TELEVISION NE

month's cover is a 31-foot cabiner which carries a full complement of electronic devices including *Emerson* (Emerson) 35-watt telephone. The unit covers four bands and a spare (two ship-to-ship; one Guard emergency; one marine—System—telephone channel; and a spare). Calls may be made to any phone by contacting the nearest telephone operator. The cost of the call is the regular toll charge plus an additional fee of \$1.00. There is no monthly carrying or minimum usage.

The boat also carries a *Bludworth* radio direction finder, the Model DF1029A. This unit covers the bands (one of which is the broadcast band) and has a range of 10 miles. It will operate on 6, 12, or 24 volts d.c.

The depth finder aboard the craft is a *Index* recording model which is capable of measuring depths from 0 to 100 fathoms (0 to 600 feet). It has a single range and may be operated from either 12 or 32 volt power sources.

Other units include a *Surrette* battery charger (12 volts) and an *Eico* Model 1040 battery charger for 6 and 12 volts. This latter unit can be used to provide the requisite 6 volts needed to operate small appliances aboard the boat, the major pieces of electronic equipment being operated by either 12 volts or 117 volts a.c. The a.c. is available in ports and is fed into the boat by means of an outlet in the rear cockpit. The boat carries dual wiring which permits the lights, battery charger, small appliances, the television set, etc., to be run from the a.c. power lines when the boat is docked. The Model 1040 battery charger also provides power for the regular 6 volt car when in port.

A meter to measure transmitter output is an extremely useful item as it tells at a glance whether or not the signal is getting out. A "Charger" which indicates the charge on all of the boat's four batteries by a series of switch completes the operating gear aboard. In addition, a television receiver and a radio receiver are provided for the entertainment of guests.

While all of the equipment aboard is standard, it may be a little more elaborate than that desired by the average boat owner. Radiotelephone units (RCA, Pearce-Simpson, Hudson-American, Fisher, etc.) range in price from around \$230 to \$760. They may be obtained with as few as two channels or as many as six and provide coverage from a minimum of 20 to 100 miles. Installation charges are extra. Crystals for the various bands are about \$15.00 a pair. Antennas for use with such equipment range in price from a modest \$25.00 for a home-built unit comprising a bamboo pole, some wire, and a swivel socket to a commercial unit in the \$80 price class. Incidentally, the swivel socket is a "must" for sailing under stationary bridges or up tree-lined inlets, etc.

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It To The Soldering Tool
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1683 College Avenue, ANGOLA, INDIANA

Direction finders fall in the \$200 to \$400 price class and range from units which operate from four self-contained batteries and cover 100 miles to units which operate from the boat's 6, 12, or 32 volt power supply, cover three bands, and are effective for distances up to 125-200 miles. One recently announced unit which has been especially designed for small boats and lean pocketbooks is being offered at a price in the neighborhood of \$85.00. This simple device consists of a receiver capable of tuning the marine, aircraft, and local broadcast bands, an earphone, and an antenna.

Depth finders, as produced by *Bendix* and *Raytheon*, are priced from \$350 to around \$1000 depending on the features incorporated. One modestly priced unit features a rotating disc and indicator light. It reads from 1 foot to 160 feet. Another model has two ranges, one for 1-100 fathoms and the other for 1-200 fathoms, while a still more elaborate version keeps a permanent record of the bottom over which the boat is traveling.

Needless to say, there are any number of other devices which can be included should the size of the boat and the wishes of the owner so dictate. *Radiomarine Corp.* is now offering a compact 3.2 cm radar unit which has been designed for small craft while a photoelectric-type automatic pilot which operates on the gyro principle is being made available to yachtsmen who do a lot of open-water cruising over long distances.

While many of the items described herein may appear to be unduly elaborate for a small craft, in reality none of the items could be considered "luxuries" since, in conditions of fog or bad weather, every single piece of electronic gear becomes a "life-line" which may be responsible for saving the crew and/or the boat itself—a point well worth considering.

No matter how few or how many

pieces of electronic equipment you have aboard, take the word of an experienced "skipper" when he advises that the more protective devices available the more comfortable and trouble-free the cruise. Being ready for any emergency is one of the marks of an "old hand". Electronic gear helps you to anticipate such emergencies and handle them smoothly should they be unavoidable. —30—

DELTA CONVENTION

AMATEURS of the Delta District will hold a convention in New Orleans on September 5-6 at the Jung Hotel on Canal Street.

Sponsored by the Greater New Orleans Amateur Radio Club and by the West-side Radio Club of New Orleans, a full program of sightseeing, convention sessions, and displays has been planned for amateurs and their wives.

Contact A. L. Powell, W5MXQ, at 224 Hollywood, New Orleans 20, La., for further information. —30—

HAM CLUB ACTIVITIES

THE Baltimore Amateur Radio Club, Inc. has scheduled its Sixth Annual Hamfest-Picnic for Sunday, August 9th at Triton Beach, Mayo, Maryland. Tickets are \$1.00 per person (children half price) and include the use of the bathing facilities, bath-house, locker, use of picnic tables, and pavilion.

An interesting program has been planned and there will be awards for the best mobile installations. The festivities are scheduled to start at 10 a.m. W3PSG will be on hand to guide visiting mobiles.

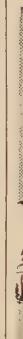
For further information write Chairman Ernie Dobos, W3JCL, 2208 North Fulton Avenue, Baltimore 17, Maryland.

* * *

THE Seventh Annual Ham Outing of the Buckeye Shortwave Radio Association will be held August 30th at Happy Days Camp, Virginia Kendall Park, located just north of Akron, Ohio on Route 303, .8 mile west of Route 8.

Registration is set for 2 p.m. with a fee of \$2.00 per family. Prizes for young and old have been provided. For further details contact R. J. Nuss, W8KDW. —30—

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... new communication tech-
and facilities ... is back in
tom once again with another
television telecasting proposal. Un-
consideration now is a "Narcom"
with Atlantic Relay Communica-
system, which calls for relays
this country to London, by way
of Canada, Greenland, Iceland, and

the earlier plan which revolved
in Near East operations about
relay stations were envisioned.
It is estimated that the network
itself alone would cost up to \$15
million, while annual network opera-
tions would involve a budget well over
\$100 million dollars. Cost
of erecting each of the relay sta-
tions would be about \$25,000, and
summing could run up a figure of
\$10 million. Then there would be the
initial problem and cost of servicing
and maintenance not only the
transmitters and associated gear, but
radio receivers, also included in
the project. According to Senator
who sponsored the measure,
\$3 to \$4 million would be re-
quired at the beginning and only
\$5000 receivers would suffice.
As present form, the global plan
will be included within a "Voice of
America" program and probably sup-
port or supplant audio transmis-
sions in certain countries.

NATIONAL TV, which reached a
critical stage a short time ago, as
deadline for reserved channels
with little reaction from com-
mercial interests, recently received
support from the headman
of Senate Interstate and Foreign
Commerce Committee, Senator
W. Tobey.

Reviewing FCC's position on school
channel, the Senator said: "I shall
keep a watchful eye on each and
one of these 242 channels for
action, and upon the slightest
evidence that the FCC is about to
act and to delete one of them or
reduce a substantially less valuable
channel for one of them, I shall
call for a full-scale investigation."

Others supported the Senator. Con-
gressman Heller pointed out that few
are aware of the ... "importance of
action taken by the FCC or of
the great significance of the gift it
presented to the American people."
He felt that reservations of the
commercial channels should continue
quietly, regardless of pressure
from the commercial world, or the
ment included within the freeze-
order.

Approval of a move to delay can-
celing of the special channels, was
voiced during the nomination
hearings of Commissioner John C.
Bricker. Senator John Bricker noted
that educational television offers great

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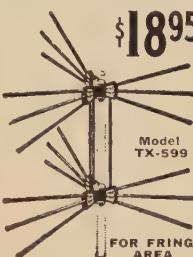
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guy rings and mtg. base.
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five directions for all
channels. You choose di-
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selector sw. mounted on
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aluminum elements.

AX-599 same as TX-599
less masts, guy ring &
mtg. base \$16.95

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- For Fringe and Ultra Fringe

High signal level for sharp, bright pictures. Hi-
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on high band. Complete
with universal U clamps.
Easy to assemble. Space-
saver design.



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in fringe and ultra fringe with
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Yagi. Completely pre-assem-
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Sturdy aluminum cross-
bar. Universal "U" clamp.
Three models cover all UHF
channels. Designed for stacking
in fringe areas.



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Stacking bars. Pr.-75c

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.003-10	.01-12	.047-15	
.0033-10	.02-12	.05-15	

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possibilities and educators should be given every chance to put up their own stations. He declared that while it would not be wise to have educational institutions take over TV, we would be . . . "passing up one of the great opportunities in the educational field, if we don't reserve channels for them."

When the reservation deadline passed, technically the Commission was in a position to change a channel from reserve for education to commercial, or even the reverse; change commercial to a reserved state. In addition, the government could add a new channel to any city, whether it presently has channels allocated to it or not, and could also remove a channel from any city and assign it to another. It also became possible to substitute or exchange channels among cities, whether they were on the very-high or ultra-high bands. A change in the minimum mileage separation required between a channel in one city and a co-channel or adjacent channel in another city now also can be entertained.

In some quarters, educational interests have been very active. In New Jersey, for instance, a commission report to the governor proposed the erection of a six-station network and allotment of \$190,000 to continue research in programming, already under way at New Brunswick, and \$425,350 for construction of station and allied facilities.

Suggested was the building of a station with a studio on the campus of Rutgers University, using a 5-kilowatt transmitter and antenna at Washington Rock State Park, Watchung. Other stations, it was reported, would be built in the vicinity of Montclair, and another with a studio in the Camden area with the transmitter and antenna in the Mount Holly vicinity. Still others would be erected in the vicinities of Freehold, Hammonton, and Andover. Local boards of education would be responsible for

providing receiving facilities, the report continued.

Among those who served on the report commission were Drs. Elm W. Engstrom of RCA and Allen DuMont. Engstrom served as chairman.

MICROWAVES, often described as the eventual home of many, many services, was recently the subject of one of the most searching analyses ever offered by a spokesman of the Commission; Edwin L. White, chief of the Safety and Special Radio Services Bureau.

Speaking before the Petroleum Industry Electrical Association in Houston, Texas, he said that the outstanding characteristic of microwave systems is the ease with which the radiations of the transmitters and angle of acceptance of receivers can be restricted. In view of this feature, the same frequency can be used in the same geographic area by two independent point-to-point systems, without noticeable interference, it was pointed out. If the engineering can be carried to the ultimate, White said it might well be that, as a matter of policy, the Commission could assign identical frequencies to a number of systems in the same area without harmful mutual interference resulting.

Exploring some of the benefits and some of the possible drawbacks of such a procedure, the Commission expert said that if such a procedure is practicable, the number of potential channels in any one area could become so large that some of the means of frequency economy applied to individual systems might become unnecessary. For example, he pointed out, it may not make too great a difference if passive reflectors are used, and frequency requirements for any point-to-point system doubled thereby. The bandwidth required for multiplex might not be of great importance, it was revealed. Under such an id-

NEW TV STATIONS ON THE AIR

(As of July 25, 1953)

The following new stations brings the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	POWER (IN KW.)
Kansas Hutchinson	KTVH	12	204-210	4.79	115
Minnesota Rochester	KROC-TV	10	192-198	5.08	105
Missouri Kansas City	KCTY	25	536-542	1.83	93
Nebraska Lincoln	KFOR-TV	10	192-198	5.08	59
Ohio Akron	WAKR-TV	49	680-686	1.44	145
Ashtabula	WICA-TV	15	476-482	2.06	20
Texas San Angelo	KTXL-TV	8	180-186	5.43	11
Texarkana	KCMC-TV	6	82-88	11.8	18.5
Wisconsin Madison	WMTV	33	584-590	1.68	16.5
Milwaukee	WCAN-TV	25	536-542	1.83	105

*From Station CP application.

The frequency of the video carrier = $1.25 + \text{channel lower freq. limit}$. Total number of television stations now on the air: 207 (49 of which are u.h.f.).

the report added, the Commission could allow each system to be as applicant might desire, both as choice of equipment and as to ultimate capacity, and there would be no need to inquire into the plans of the applicants for future growth. Thus, Commission might assign a channel from 8 to 10-mc. width to each microwave system, leaving it to the licensee to make his choice of modulation system, and use as much of the channel as his needs dictate, provided, of course, that the techniques used did not result in occupancy of frequencies outside the channel or produce radiation outside of the geographic area provided for the system.

Unfortunately, White said, for some time there were a few problems that could curb the bright prospects. For the cable and broadcast systems, the frequencies above 800 or 900 mc. are too attractive. And, information also indicates that above approximately 10 or 10,000 mc., atmospheric absorption is also serious. Because of these conditions, the report noted, it will be that at some future time we may find that because of requirements for mobile uses we cannot afford to use the frequencies below 800 mc. for point-to-point communications. This should happen, White declared, point-to-point systems designed to operate in the lower portion of the spectrum would be forced to vacate and move up to those frequencies suitable for point-to-point, but unsuitable for mobile work. Notwithstanding the difference situation above 10,000 mc., extremely high powers can be used to overcome this atmospheric problem, as radar operation has proved. Under these circumstances, petroleum specialists were told, fixed frequencies between 800 and 10,000 mc. might be reserved for inter-city point-to-point systems and the higher frequencies above 10,000 mc. could be reserved for intracity networks and to connect the suburban

terminals of intercity networks with central urban terminals.

Noting that the number of microwave systems is growing, White disclosed that there are approximately 60 fixed microwave communication systems which are over 50 miles in length, in addition to possibly 75 to 80 other systems which consist of one or two hops only.

FACED WITH mounting hearing problems, examiners have found it impossible to maintain the early post-freeze pace and grants have begun to trickle instead of pour as they did in the first few months.

As the table on page 16 reveals, the number of approvals for station construction has dropped substantially; over 50 per-cent in this instance as can be readily seen.

It is believed that this situation will be alleviated soon by Congress by means of an appropriation to permit the hiring of more examiner teams. It is expected that about \$300,000 will be appropriated for the cause, and at least seven more teams of examiners will be retained. Since one team can handle about 15 applications yearly, the present ten and additional seven would be able to process 255 applications a year. Senator Ed Johnson has been arguing for even more money so that more lawyers and assistants can be hired to expedite further the processing of applications. He warned his colleagues that actually Congress would be continuing the freeze if they did not approve funds for more examiner teams. He would like to see a total of 40 teams in action at the Commission's offices. Such a force, he felt, would enable more stations to begin telecasting and set in motion a chain reaction which very quickly would create billions of dollars in business. Everyone is grateful to the driving Senator for his earthy plea for these urgently needed dollars. It is to be hoped that Congress concurs....L.W.

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16KP4	19.50
16LP4A	21.60
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17CP4	19.60
17CP4	20.60
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Four Element Straight Low Quick Rig	4.25	3.25
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PENTRON Model ST3C — 2-speed Tape Recorder	Write for Price.
RADIO CRAFTSMAN Model C400-High Amplifier	Net	42.90
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Model C500-Williamson Amplifier	Net	99.50
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6x9 PM Speaker	\$ 3.98	630 Vert. output
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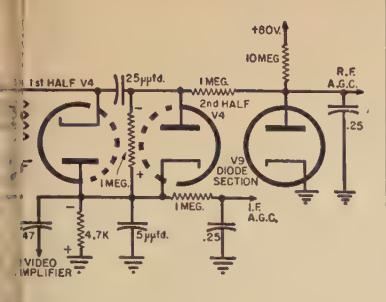
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MODEL RC-

REGAL



Simplified schematic diagram of a type a.g.c. circuit used by Emerson.

voltage developed across the video load resistor serves as the source for the i.f. stages only. (Fig. 6.) Since in the strong areas the r.f. amplifier must surely be cut off, or close to it, higher a.g.c. potential is developed in the modified voltage-doubling action of the second-section diode of V_4 . A peak d.c. voltage will then add average voltage across the resistor, giving the total voltage the r.f. a.g.c., reducing the r.f. in the high-signal area. For signals, the action of the modified voltage doubler is reduced by applying a positive voltage through a 10-megohm resistor from a 10-volt source, reducing the r.f. to some value close to zero. If the section of V_9 were removed from the circuit while receiving a signal, the r.f. a.g.c. line would be positive. The a.g.c. clamper diode prevents this from occurring by conning whenever there is a tendency for positive voltage to exist on the a.g.c. line. Actually, this a.g.c. will never become positive, due to contact potentials of the diodes, will always be approximately -5 with no signal received.

low value of negative voltage is present on the r.f. a.g.c. line if the signal is strong enough to drop a large enough bias in the diode circuit to overcome the negative delay voltage from the 80-volt source. From that point on, the voltage will rise very rapidly as signal increases, crossing over the r.f. a.g.c. bias point (see Fig. 5C) for very strong signals, cutting the r.f. amplifier.

The vertical oscillator frequency is controlled directly by the vertical pulse after it is integrated by an oved integrator network. This oved integrator is made up of two sections of a low-pass network, R_{44} , C_{44} , C_{45} , and C_{46} , rather than the ordinary three sections. Also, the impedance is lower which makes operation more successful, since noise or horizontal pulses that induce currents into the vertical circuit will develop a negligible voltage across the low resistance of the otor. Another important factor at, with the two-section integrator, the time constant is shorter, before permitting the vertical sync to discharge fully after the ver-

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Radar Indicator unit for conversion to test scope or for use as a modulation monitor. Complete with tubes. But, less 5BPI. New

\$9.95



SCR-625—Mine Detector—New \$59.50
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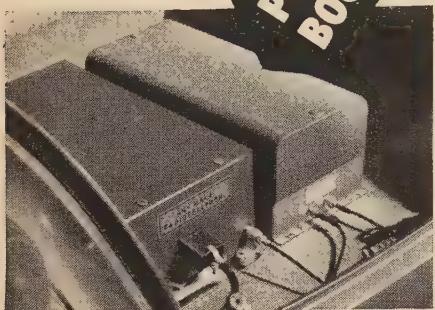
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tical pulses are removed, within the time interval of the equalizing pulses. This arrangement permits improved interlace, allowing the receiver to have its maximum resolution and resulting in better picture quality.

The horizontal sync circuit uses the latest type of horizontal phase-detector circuit as an automatic frequency control. As seen from the schematic diagram in Fig. 4, the horizontal multivibrator (V_{13}) frequency is not controlled by pulses, as is the vertical circuit; instead, a d.c. control voltage is applied to its grid from the output of the phase detector. This voltage is negative or positive, depending upon the relation of the multivibrator frequency to the horizontal sync pulse. Increasing the horizontal frequency, or to be more correct, its phase, is accomplished by making the grid of the first half of V_{13} more negative, decreasing its gain, but resulting in an increase in horizontal phase. To decrease the horizontal phase, a positive voltage is applied to the grid.

Noise Inverter Circuit

To improve the noise immunity of the circuits, early receivers used a noise clipper diode. The noise was clipped by the diode action down to the level of the sync peaks, at best, if the circuit was adjusted properly. The remaining noise pulse below the sync level, however, could still cause unstable sync. Also, under continuously heavy noise bursts, the noise clipper tended to build up a bias across it equal to the noise peaks and, therefore, was not effective for the elimination of such noise.

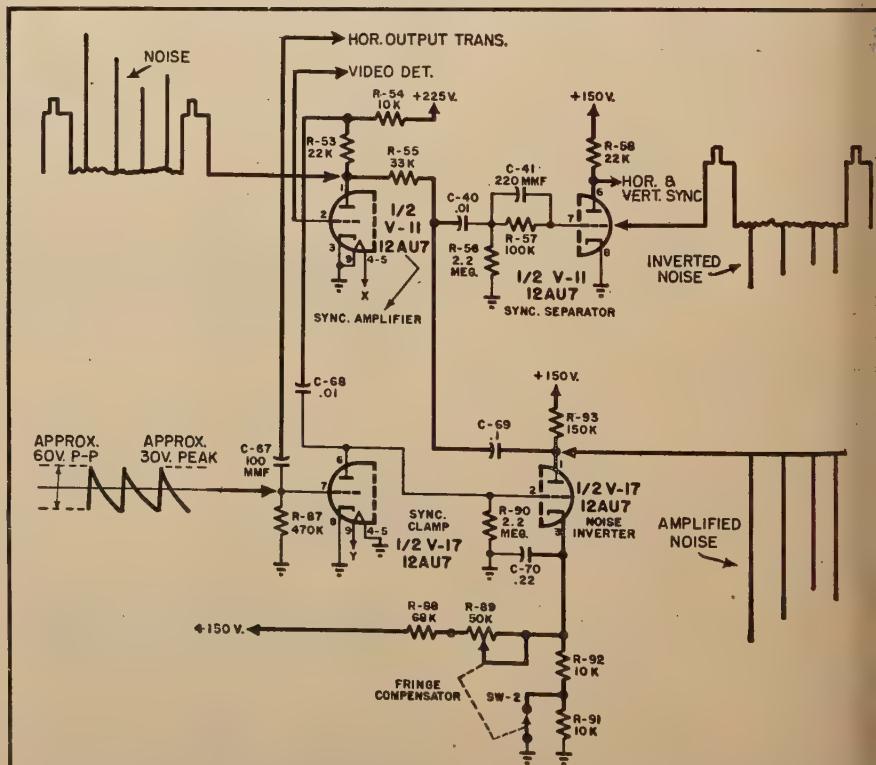
The Emerson noise inverter circuit, Fig. 7, not only prevents the noise

from exceeding the sync peaks, but also reverses the polarity of the noise pulses into the negative region, where they have absolutely no detrimental effects on the sync circuits. It should be noted that the noise inverter circuit will function on noise in the sync circuit only, and not in the video circuit. Noise appearing at the output of the video detector will appear on the picture tube.

The normal path of the sync pulses with the noise inverter inoperative would be from the video detector through the sync amplifier, through an RC noise-immunity circuit to the sync separator and, finally, to the horizontal or vertical sync circuit. In operation, one-third of the output voltage of the sync amplifier is taken off from the junction of resistors R_{54} and R_{55} , and is applied to the grid of the noise inverter. The variable resistance, R_{59} , which is part of a voltage divider in the cathode of the noise inverter, is adjusted so that the bias of the tube is just at cut-off when no signal is received. The total bias on the grid of the noise inverter must always be equal to the cut-off bias of the tube, plus the peak voltage of the sync pulses. The latter varies from scene to scene, and is coupled to the noise inverter grid. A varying bias voltage that will follow the sync amplitude variations is developed on the grid, due to the action of the sync clumper in the following manner.

Pulse voltages, which are a function of the horizontal frequency, are obtained from the horizontal output transformer and are applied to the grid of the sync clumper at the same instant that a horizontal sync pulse is applied to the plate of the clumper.

Fig. 7. Noise inverter circuit showing the waveforms at essential points.



leak bias will develop on the clumper from the grid pulses it will keep it cut off between vital pulses. When the clumper does conduct, it charges C_{68} up to peak voltage of the sync pulses and, its discharge through R_{90} sets a bias voltage equal to the peak of the sync pulse. Adding the bias developed across R_{90} , and the bias in the cathode circuit of the inverter, results in the total bias for the tube, maintaining it at the cut-off potential.

When the clumper does not conduct, it appears as a high impedance preventing the noise pulses to overcome bias on the noise inverter, driving conduction. These noise pulses are amplified and appear across the 10 ohm resistor, R_{55} , with an opposite polarity and greater amplitude than the same noise coming from the end of the sync amplifier. The latter pulse is therefore cancelled completely, and appears as a negative noise pulse having no harmful effects anywhere in the sync.

Although the setting of R_{90} is not critical, care must be taken so as to develop excessive or insufficient bias. With excessive bias, not all of the noise will cause the tube to conduct and this will result in inadequate inflation. With insufficient bias, there is the possibility that the sync will be cancelled, adding to sync instability. This variable resistor is the "fringe compensator" and its adjustment is simple. It is rotated until noise does not affect any sync instability of the picture on the screen. If the fringe compensation operation is not desired, the dial is rotated fully counterclockwise until SW_2 is opened, removing the bias across R_{51} . The increased voltage drop across the additional 10,000-ohm resistor biases the tube well beyond cut-off.

Alignment Data

To aid the service technician in aligning the horizontal oscillator, leads from the multivibrator phase coil and from the grid of the horizontal oscillator are brought up to a terminal lug on the top rear of the chassis. Since the multivibrator control grid must be at zero voltage for operation at 15,750 cycles, the lug connected to the grid is simply shorted by a jumper to the chassis of the tuner. Another jumper is used to connect the other two closely-wired leads from the phase coil to each other. All controlling elements of the tuner are removed, leaving the total RC time constant. The horizontal hold control, R_{78} , located on the rear of the chassis behind the hinged front name plate, is adjusted so that it is in the center of its mechanical range. With the set tuned to a vertical, the horizontal balance control, located on the rear of the chassis, is adjusted so that the picture does not tear. Next, the jumper shorting leads connected to the phase coil is



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1A7GT	\$.30	6BL7	\$.59	12BE6	\$.39
1AB5	\$.65	6BQ6GT	\$.59	12BF6	\$.39
1B3	\$.30	6C1	\$.59	12BH7	\$.63
1B7GT	\$.30	6BZ7	\$.95	12BY7	\$.55
1CG5T	\$.43	6C4	.37	12CB8	.34
1E7	\$.29	6CG7	.39	12FSGT	.34
1G4GT	\$.24	6C6	.24	12J5GT	.42
1G6	\$.30	6DG	.24	12K1T	.34
1H4G	\$.30	6CB6	.44	12K7GT	.44
1H5GT	\$.40	6CD6G	1.11	12S8	.70
1H6	\$.24	6D6	.45	12SA7GT	.44
1J6	\$.24	6F2	.48	12SF5	.50
1L4	\$.46	6FSGT	.39	12S7GT	.52
1LC5	\$.51	6F6	.37	12SJ7	.44
1N5	\$.46	6F8G	.24	12SK7GT	.48
1P5	\$.57	6G1	.55	12SL7GT	.47
1Q5	\$.45	6H6GT	.37	12SM7GT	.52
1R5	\$.45	6J5GT	.31	12S07	.44
1S5	\$.39	6J6	.52	12SR7	.49
1T4	\$.45	6J7G	.43	14J7	.30
1T5	\$.33	6J8	.53	14M7	.30
1U4	\$.39	6K5	.47	19BG6	.95
1U5	\$.39	6KG7	.37	19C8	.70
1V	\$.60	6K7	.44	19T8	.79
1X2	\$.65	6L5	.24	22A4	.63
2A3	\$.70	6L6	.64	25AV5	.83
2A4G	\$.24	6O7	.45	25BQ6GT	.62
2X2	\$.48	6S4	.38	25LG6GT	.39
3A4	\$.45	6S5	.53	25Z5	.40
3E4	\$.45	6S7GT	.41	25Z5GT	.37
3Q4	\$.48	6SD7GT	.46	26	.45
3Q5GT	\$.49	6FSGT	.41	27	.39
3S4	\$.46	6SG7GT	.46	32L7	.49
3V4	\$.75	6S7GT	.41	35B5	.40
5V4	\$.73	6SK7GT	.41	35C5	.39
5W4	\$.50	6SL7GT	.48	35LG7GT	.41
5X4	\$.40	6S7GT	.37	35W4	.37
5Y3G	\$.22	6SO7GT	.37	35Z4	.37
5Y3GT	\$.35	6SS7	.45	35Z5GT	.37
5Y4G	\$.35	6SS7	.42	36	.60
5Z3	\$.46	6T8	.56	41	.42
6A8	\$.62	6U4	.60	42	.42
6A84	\$.44	6U5	.63	43	.55
6AG5	\$.43	6UB	.61	45	.55
6AJ5	\$.15	6VAF7	.38	47Z7	.49
6AL5	\$.38	6WAG7	.44	50B5	.39
6AQ5	\$.39	6WG7	.44	50C5	.39
6AO6	\$.37	6X4	.37	50C6	.59
6A9	\$.37	6X5GT	.61	50LG7	.41
6A95	\$.50	6X7	.56	50Z5	.50
6AT6	\$.37	6Y6G	.48	53	.24
6AU8	\$.38	7AF7	.53	55	.58
6AV6	\$.37	7B7	.44	58	.60
6AX4	\$.53	7E6	.30	70L7GT	1.09
6AX6G	\$.24	7X7	.70	76	.44
6B4G	\$.64	12A28	.56	77	.57
6B5	\$.59	12A4LS	.37	78	.47
6B47	\$.57	12AT6	.37	80	.35
6BC5	\$.44	12AT7	.56	83	.68
6BC7	\$.34	12AU6	.43	85	.59
6BG5GT	\$.39	12AV7	.59	117L7	.99
6BD6	\$.45	12AV6	.39	117Z3	.37
6BE6	\$.39	12AV7	.59	807	1.19
6BF5	\$.41	12AX4	.59	1274	.99
6BG6G	\$.57	12AZ7	.48	220	1.15
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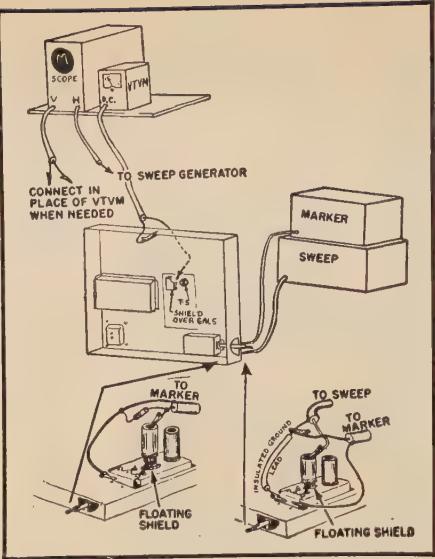


Fig. 8. Test equipment setup for video i.f. alignment outlined in Table 2.

removed, and the phase coil is adjusted so that the picture does not tear.

Note: Since no a.f.c. voltage is being applied to the multivibrator during the above adjustments, the horizontal blanking bar may move back and forth across the face of the picture tube.

To complete the adjustment, the jumper shorting the grid of the multivibrator is removed. The horizontal hold control should hold over the entire range if it is rotated slowly. If the horizontal should tear at only one end of the control, it is still within engineering specifications.

Before aligning the video i.f. stages of the receiver, do the following:

a. Tune the receiver to unused Channels 10 or 12.

b. Connect the negative terminal of a 3-volt bias battery to the i.f. a.g.c. This connection should be made at the junction of R_{10} , C_8 , and R_{16} (see Fig. 4). Connect the positive terminal of the bias battery to the chassis.

c. Raise the shield of the 6J6 converter tube, V_{23} , slightly so that it does not make contact with the chassis. (See Fig. 8).

d. The output cable of the sweep and marker generators should be properly terminated in their characteristic impedance (usually 50 to 75 ohms). If this termination has not been built into the end of the cable, connect a resistor of the same value as this characteristic impedance across the output of each generator cable, as shown in Fig. 8.

e. Proceed to step 1 on Table 2. -30-

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(Continued from page 49)

The resistance from the plate cap to the output tube to the low end of the flyback transformer will probably range from 15 to 60 ohms.

If the click and spark are not obtained, the output stage is either defective, the boost voltage is absent, the output stage is not being driven by the horizontal oscillator circuit. This now requires the use of test equipment to locate the trouble.

Use a vacuum-tube voltmeter to measure the bias between grid and cathode pins on the output tube. Anything less than 20 volts is indicative of insufficient drive. If approximately 30 or more volts is obtained, check the damper by measuring the bias voltage at its cathode. If the bias voltage, which is usually a little less than twice the "B+" voltage, is not obtained, the damper stage or the flyback transformer may be defective. Make sure, of course, that the bias voltage fuse (if there is one) is not blown. If the aforementioned test fails to locate the defective part, use a scope to check the waveshape at the grid of the output tube. Since this is a qualitative analysis and waveshapes differ from receiver to receiver, it is difficult to give a hard and fast rule as to what to look for. However, Table 1 contains the general waveshapes and potentials obtained for a number of representative receivers. Failure to obtain these waveshapes and/or potentials indicates that the trouble lies between the grid circuit of the output stage and the horizontal oscillator circuits.

There are many troubles that do not cause the complete loss of high voltage, or which affect the width, linearity, etc. Among the most common troubles of this type are the following.

Picture Blooming: Due to a faulty high-voltage rectifier tube. Replace the tube, and if a doubler circuit is used, replace both rectifier tubes.

Insufficient Width: Caused by weak low-voltage rectifiers, or a weak output tube. Check the output tube and the screen grid components. If the linearity on the left side of the screen is affected more than on the right, check the damper tube and associated components. Check the boost voltage and the boost filter, such as the μ fd. condenser connected to the damper cathode (see Fig. 3).

Output Tube Requires Frequent Replacement: (more than once a year). Check the grid coupling condenser, which may be leaky, causing excessive current to be drawn. Also, check the grid waveform to make sure that the tube is not being overdriven. In either case, a check of the bias will reveal the tube is drawing excessive current.

In cases where the trouble has been traced to a defective flyback trans-

HAM CLUB ELECTS

MILWAUKEE Radio Amateurs' Club has named K. W. Eggert, W9MOT, president; Dr. G. P. Lawrence, W9RZJ, first vice-president; C. W. Thomas, W9WK, second vice-president; W. E. Herzog, W9LSK, secretary; and E. J. Belanger, W9MDG, treasurer for the year 1953-1954. Four directors were also elected.

-30-

it is very important that an replacement be made if additional troubles are to be avoided. Direct replacement sometimes does not work properly due to the heat aging of components, or a us incorrect substitution of may have produced operating conditions which are so far off tolerance that the rear apron controls can trigger reset the circuit for the results. Some of the more common troubles resulting from such switches, and the cures for them, are described below.

After replacing a flyback, insufficient width results, try shunting the flyback coil with a condenser whose value is between .025 to .05 μ fd. Another method is to increase the output coupling condenser in increments no higher than 10%, or to decrease the value of the screen dropping resistor in steps no higher than 10% or combinations of both. If the screen voltage is too low, reduce the resistance across the width coil in increments of 20%, or increase the bias and/or screen voltage as required for insufficient width. If excessive high voltage is obtained, reduce the drive to the output-tube by decreasing the size of the output condenser, or increasing the value of the screen-dropping resistor. If fails, insert a 1000 ohm, 10 watt potentiometer in series with the plate of the flyback and the "B+" supply. Adjust the pot until the high voltage is reduced a sufficient amount. Remove the pot and substitute a 10-watt fixed resistor of a value determined experimentally.

To alternate light and dark vertical lines, modulate the raster, check the power stage and the drive to the grid of the output tube. If parasitic oscillations develop, insert a 47- to 68-ohm bypassing resistor in the grid circuit of the output tube, and a 68- to 82-ohm resistor in the screen circuit. Parasitics can also be suppressed by means of a magnet clamped to the output tube or by redressing the leads connected to the flyback transformer. If horizontal foldover develops, first check the horizontal a.f.c. circuits for correct adjustment, and then check the width and linearity components. Try substituting a number of different output tubes to obtain the best match. —30—

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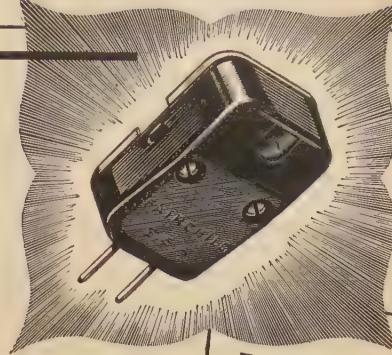
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Up until last Fall the cheapest "camera chain" available for closed circuit TV sold for more than four thousand dollars. These units were sold directly by their manufacturers and were installed and maintained by factory service people.

Last Fall the *Dage Electronic Corporation* introduced a TV camera that carries a list price of \$2850.00. When this camera was announced the *Dage Company* was literally swamped with inquiries about it, clearly demonstrating the tremendous interest already existing in the field of closed-circuit television.

In the span of less than a year's time closed-circuit TV camera systems have dropped in price from more than five-thousand dollars to less than one-thousand dollars. The most important factor in the cost of a TV camera is the price of the camera tube. The present list price of the Vidicon tube is around \$400. RCA is said to be stepping up production of this tube and it is possible that production efficiencies and economies will result in a steady lowering of the price of this popular tube.

It is obvious that *Radio Corporation of America* visualizes closed-circuit television as a potentially immense business in its own right perhaps, as Mr. Sarnoff said, "even surpassing the growth in broadcast television we are now witnessing."

Last Fall, speaking before the NEDA convention in Atlantic City, Hal Bersin, renewal sales manager for the *RCA* tube department, told parts distributors assembled there, "Today, now, ITV is practical for millions of applications. Do you realize that in this statement we are suggesting that millions of television cameras may someday be placed in service? Have you considered the possibility of stocking Vidicon camera tubes, as you now do with 6L6's?"

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panded the scope of their activities to handle other facets of service in the electronics field like AM-FM radios, auto radios, and mobile 2-way communications systems. In some cases, to level off seasonal fluctuations, these service executives have gone into home air conditioning, low voltage house wiring, and major appliance installation and maintenance.

It is for these businesses that closed-circuit television holds the greatest immediate opportunities. In most of our discussions of ITV we have dealt with monochrome systems. Substantial progress has been made in perfecting color TV equipment for closed-circuit work. Color TV has an especial appeal in medical applications and it is reported that one company is now in production on color TV cameras and monitors with the idea of aggressively exploiting the ready markets for this type of equipment. It is the plan of this organization to arrange for the installation, maintenance, and service of its systems by competent, independent TV service companies.

However, it is imperative that any TV service organization that wants to share substantially in the growth of closed circuit television must start now to prepare its personnel in both camera circuitry and application idiosyncrasies of this type of electronic equipment. Where it was possible to learn a lot about TV service and installation through 'cut and try' in the early days, closed circuit installation and maintenance will require expert technical 'know-how' right from the start.

Hi-Fi Future

One of the most interesting developments in recent months is the announcement by such primarily radio and television firms as *RCA*, *General Electric*, *Admiral*, *Philco*, and *I.D.E.A.* ("Regency") that they are entering the high-fidelity audio equipment field. These and other companies are finding out, just as *Stromberg-Carlson* did almost a year ago, that there is a strong and ever-growing market for "packaged" high-fidelity systems or individual units which have been engineered to work together to produce the best results. These "matched" sets, which can be purchased at one time or added as the customer wishes, are gaining an enthusiastic acceptance among audiophiles.

The tremendous interest in high-fidelity reproduction that music lovers have shown during the past two years through their attendance at audio equipment shows in various parts of the country, indicates an ever-widening interest in custom-installed sound equipment in the home.

The bottleneck in the exploitation of the high-fidelity market has been brought about by the wide variety of methods employed in distributing the equipment which is of interest to the mass market of home owners. Service businessmen have not been interested in promoting custom-installed sound

equipment because after they have spent the money and time getting the customer interested in high fidelity equipment the customer will discover where he can buy the units at deep prices and either buy them himself or drop the idea with the feeling that the service dealer is profiteering his expense.

In numerous instances service operators have shown your editors where after they had spent considerable time in detailing an installation of sound equipment for a church or a commercial organization, the principals involved bypassed them and bought the necessary units from a local parts distributor. In selling custom-installed sound equipment it is necessary to give the customer a layout of where the units will be placed, how the wiring will be accomplished, and details of the units that will be used in the installation.

A novice to the hi-fi field, figuring on an investment in custom-installed equipment, quickly finds other hi-fi enthusiasts who know all the answers particularly about where you can buy the elements for a high-fidelity system at the lowest cost. When that happens the retail dealer who developed the interest is out of luck. He does not have a chance to close the sale or get any return on the time and knowledge he has given in developing the consumer's interest.

This situation has brought aggressive selling of high fidelity equipment to a standstill at the consumer level.

The unfortunate part of this situation is that the tremendous mass market for custom-installed hi-fi equipment will remain unexploited because of the lack of aggressive promotional activity at local levels. The present hi-fi market is largely comprised of the audio enthusiasts in the half million segment of our population who are familiar with the elements of electronic circuitry.

This impasse may be broken someday by some manufacturer or combination of manufacturers who set up sales programs for package sound units that will be available only through authorized dealers capable of installing and maintaining it. A "package" of quality equipment aggressively merchandised to home owners would find a receptive market among the many thousands who would appreciate the pleasure of high fidelity sound without the bother of trying to understand how it is accomplished.

Service Business Categories

When you speak of an electrical service business, the average man visualizes a one-man shop with the owner busy plying a soldering iron to the innards of an up-turned radio or television receiver. But while industry attention has been directed largely to the expanding base provided by new products and extension of manufacturing and distributing facilities, a great many changes have been taking place.

businesses devoted to the service-electronics products. We felt it be of interest to our readers in service business to know the many areas into which the activity has spread:

- Television (installation and service)
- (a) TV Service—dealer operated
- (b) TV Service—wholesale—for non-servicing dealers
- (c) TV Service—consumer only—complete service home and shop
- (d) TV Service—installations only—for dealers
- (e) TV Service—drive-in—customer brings set in—picks it up after service is completed.
- M-FM radio service
- Phono service—automatic changers specialists
- Auto radio specialists
- Wire and tape recorders
- Audio equipment—(industrial and commercial)—sales and service
- Mobile 2-way communications equipment
- Industrial electronics maintenance
- Community and apartment house TV systems.

Their travels about the country editors have found several thriving businesses that specialize in the selling of wire and tape recorders. This type of equipment, now widely used in businesses and by professionals, has been passed up by most radio operators. On the other hand, typewriter sales store that were selling wire and tape dictating machines soon found the adjustment servicing of recorders to be a profitable avenue that supplies a constant volume of business.

Bulletins Available

From time to time we have offered bulletins to our readers which cover such subjects of interest to people

engaged in the service business. From time to time we get letters from readers asking for bulletins that were offered several years ago. Unfortunately, most of these bulletins are out of print.

At the present time we have the following bulletins available to those who would like to have them:

1. Financing a TV Service Business
2. Standard TV Labor Pricing Schedule
3. Your Market—Replacement phono needles, cartridges and changers
4. Closed Circuit TV—Opportunities for Independent Service Businesses.

In requesting bulletins address your letter to: TTLB Information Service, P. O. Box 1321, Indianapolis 6, Ind., and include an addressed, stamped envelope. Twelve cents in postage is required for all four bulletins listed above.

-30-

AMATEUR TELETYPE

THE Southern California Radio Teletype Society, an amateur group, has been publishing a highly informative and professionally laid out bulletin called "RTTY" since January of this year. "RTTY" carries articles on amateur teletype equipment and techniques, reports on station and network activities, and supplies information on the availability of equipment, etc.

A page called "Tape off the Floor" gives interesting gleanings from conversations between amateur teletype stations all over this country and Canada. The SCRTS and "RTTY" plan to make an "Amateur Radio Teletype Handbook" available late in September.

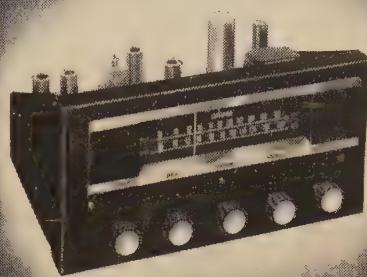
Subscription to "RTTY," which is non-commercial and non-profit, is not restricted to SCRTS members and may be had by anyone for \$1.80 a year, which covers the cost of printing and mailing. Further information may be obtained from Merrill Swann, W6AEE, at 3769 East Green Street, Pasadena 10, California, the address of the Society.

-30-

Over-all view of the manufacturing area of Allen B. Du Mont Laboratories' new Instrument Division plant in Clifton, N. J. The new facility contains 118,000 square feet of space for the development and manufacture of cathode-ray instruments.



The C-800 is here to bring you new record performance!



the new craftsmen 800 FM-AM TUNER with built-in phono preamplifier and record equalizer

Now—Craftsmen brings you a tuner that matches all your finest records... is setting new records for versatility, too. The C-800 is further evidence that Craftsmen leadership in high fidelity is something you can put your finger on, something you can hear.

- Front-panel-selected equalization for AES, LP or EUropean recording characteristics. Inverse feedback compensated dual-triode phono preamp for correct turnover and roll-off characteristics.
- Improved AM reception. Wider bandwidth for better fidelity, and sharper IF bandpass "skirts" for greater selectivity.
- Double-shadow tuning eye and AFC (no drift) on FM simplifies tuning. Front-panel AFC cut-out for tuning weak stations.
- Efficient new layout. Bottom plate, completely shielded chassis minimize oscillator radiation, assure tuner isolation.
- Cathode follower audio output for remote installations; 2 volts at less than $\frac{1}{2}\%$ dist. Detector output also has cathode follower for recording applications.
- Bass and treble controls continuously variable from attenuation to boost—flat position clearly marked. Selector positions: FM, FM with AFC, AM, TV, LP, AES, EUR, and SPare.
- Mahogany-finish wood cabinet available.

HIGH FIDELITY—LOW COST! C-800 audio amplifier offers 10 watts ± 1 db., 15—20,000 cps., less than 1% distortion. New streamlined chassis design.

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Dept. R-8, 4401 N. Ravenswood Ave.
Chicago 40, Ill.

harmonic indicator you could for. Later I learned that Phil in the June, 1952 issue of "QST" how this very meter can be modified especially for running down TVI installing a coax connector and a set of filters and by drilling a hole in the panel so the oscillator coils be adjusted to cover an extended either side of the video carriers. is able to track down my trouble, though, without doing this."

"I am glad," Mac remarked dryly we turned the channel selector to make sure no holes had been drilled in the panel.

"Don't forget the tests we made on antennas and lead-ins," Barney said. "You had me up on the cold, roof connecting identical lengths various kinds of lead line to the antenna and pouring water down them while you sat here in the warm shop tabulating relative strength readings."

"Well, you were the one who didn't trust the attenuation figures in the books," Mac retorted;

then our findings were almost identical with the published ones. One

worthwhile we did find out, though, was which of the various

kinds of matching transformers used connecting a v.h.f. and a u.h.f. antenna to a single lead-in were the

best. By connecting the lead first to u.h.f. antenna and then to the v.h.f. antenna and noting the relative signal strength received, and then by

the various types of matching

transformers one at a time and taking u.h.f. and v.h.f. readings, we

got a clear picture of the effect each transformer had on the two signals."

The thing I like about using a field strength meter is that it teaches you

what kind of performance to expect

of each brand of receiver," Barney said. "That is important in this

area that is ultra-fringe v.h.f. but fairly u.h.f. since we got our new station. While I realize this meter is

intended to measure received signal strength in absolute microvolts—a job would cost several thousand dollars—it is a very dependable indicator of relative signal strength. Using it, we have learned

we must have a reading of ten to fifteen microvolts to make some

good sync, while others will hang

in there down to two or three

isolated microvolts. Certain models

will be snow-free when our meter

is 100 microvolts; others take two to three times this amount. Knowing

what to expect out of a set is doggone important, but first you have to know what goes into it."

"That's right," Mac agreed. "The

key is what the technician has to

work with, and with a good field

strength meter he can trace it back to the antenna terminals right up to the antenna itself. Considering the

important part that the antenna plays in TV reception, I should say that was

initial."

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1H5GT	.46	6AT6	.38	6L6G	.80	12BA6	.45
1L4	.57	6AU6	.43	6L6GA	.80	12BE6	.47
1NSGT	.57	6AV6	.38	6S4	.46	12BH7	.63
1R5	.56	6B4G	.96	6SA7GT	.52	12BZ7	.75
1SS	.47	6BA6	.45	6S17GT	.47	12SA7GT	.52
1T4	.56	6BC5	.53	6SK7GT	.50	12SK7GT	.50
1T5GT	.71	6BD5GT	.89	6SL7GT	.62	12SL7GT	.61
1X2	.67	6BF5	.47	6SN7GT	.54	12SN7GT	.54
3Q5GT	.65	6BG6	.60	6SQ7GT	.42	12SQ7GT	.44
3S4	.55	6BH6	1.34	6T8	.78	19BG6	1.39
3V4	.56	6BJ6	.57	6V6GT	.85	19EB8	.94
5U4G	.43	6BK7	1.10	6W4GT	.46	19T18	.79
5V4G	.73	6BL7	.83	6W6GT	.57	25DQ6	.89
5Y3G	.34	6BQ6	.89	6X4	.34	25L6GT	.48
6AB4	.30	6BQ7	1.10	6X5GT	.33	35AS5	.48
6AF4	.46	6BZ7	1.10	6Y6G	.59	35BS5	.47
6AG5	.54	6C4	.34	7T7	.52	35CS5	.47
6AK5	.95	6CB6	.53	12AT6	.38	35L6GT	.47
6AK6	.63	6CD6	1.85	12AT7	.68	35W4	.31
6ALS	.40	6F6GT	.45	12AU7	.43	35Z5GT	.30
6AN4	1.30	6H6GT	.49	12AV6	.55	50B5	.47
6AQ5	.46	6HGGT	.49	12AV7	.38	50C5	.47
6AQ6	.42	6J5GT	.40	12AX7	.80	50L6	.47
6ARS	.38	6J6	.62	12AX7	.61	117Z3	.39
						117Z6	

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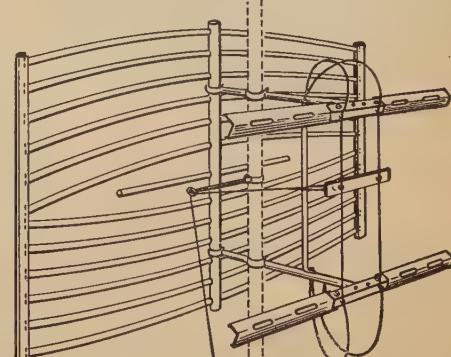
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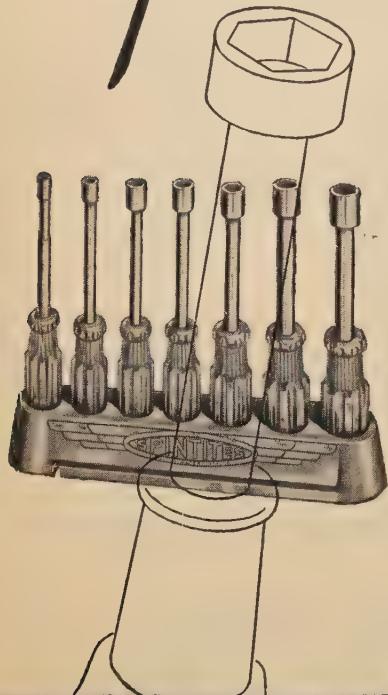
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CHASSIS 120094A

60-cycle buzz.

To eliminate such buzz from the audio when it is present even at low settings of the volume control, do the following:

1. Dress all leads to the picture-tube socket as far from the 6T8 tube as possible. This can be done by securing the green grid lead wire to the side of the cabinet.
2. If the buzz persists, realign the sound circuits and sound traps.

CHASSIS 120095B

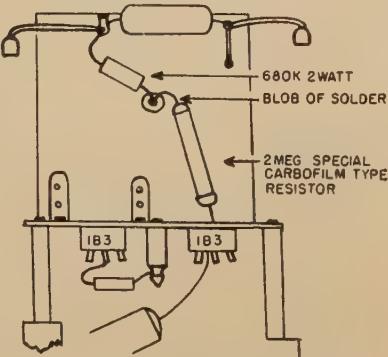
Bright noise streaks.

To eliminate such disturbances from the picture, remove the 22-ohm resistor connected between the tuner frame and "B-", and replace with a jumper wire.

CHASSIS 120109 & 120120

Replacement of the 2-megohm high-voltage resistor.

This resistor is R_{30} in the 120109 chassis, and R_{46} in the 120120 chassis. When replacement of these resistors becomes necessary, a 680,000-ohm, 2-watt Allen Bradley resistor should be placed in series with the new 2-megohm unit. No substitutes should be used for either one of these resistors. The



method of mounting is shown in the accompanying diagram. The junction of the two resistors should be looped, and a large blob of solder should cover any points or sharp ends. This prevents ionization of the air, or arcing.

CHASSIS 120118B

Loss of horizontal sync.

1. Replace the horizontal oscil-

lator and control tube (12SN7GT).

2. Replace C_{17} (.002 μ fd., 400 volt) condenser with a 600-volt μ fd. of the same value.

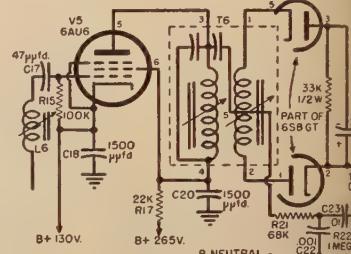
Bad arcing in raster, small irregular ripples.
Replace T_7 , horizontal oscillator and phasing coils.

CHASSIS 120123B

Intercarrier buzz.

To eliminate this condition, do the following:

1. Remove the following components from the circuit:
- a. C_{21} (110 μ fd.) connect-



between pin 5 and pin 2 V_6 (6S8).

- b. Resistors R_{19} and R_{20} (100,000 ohms) from lug 5 of T_6 , the discriminator transformer. (Lug 1 has a green dot, lug 3 has a blue dot. Numbers run counterclockwise.)
- c. R_{18} (8200 ohms) and C_{17} (1500 μ fd.) from pin 6 of V_6 (6AU6).
- d. R_{18} (2200 ohms) from the "B+" point on the terminal strip to lug 4 of T_6 .
2. Reconnect the following components:
- a. Remove pigtail of R_{21} (60,000 ohms) going to pin 5 of 6S8, and connect to pin 4 of T_6 .
- b. Remove lead from pin 3 of 6S8, and connect to pin 4 of T_6 .
- c. Add a jumper wire from lug 4 of T_6 to pin 6 of 6AU6.
3. Add the following components:
- a. A 33,000-ohm, $\frac{1}{2}$ -watt resistor in parallel with 4- μ fd., 50-volt electrolytic condenser, from pin 3 of the 6S8 to "B neutral" the nearby terminal board (second lug from tuner) with the negative side of electrolytic to pin 3 of 6AU6.
- b. Add a .001- μ fd., 400-volt condenser from pin 6 of 6S8 to "B neutral."

The accompanying diagram above shows the new circuit.

Align the sound circuits as follows:

- a. Place a d.c. v.t.v.m. (negative scale) across the 4- μ fd. electrolytic, ground terminal to "B neutral" (plus side of electrolytic).
- b. Tune in a good television station.
- c. Adjust L_6 and primary of T_6 for maximum meter deflection.
- d. Remove meter and adjust secondary of T_6 for maximum sound with minimum buzz. (The secondary of T_6 is on top for Part No. 708018; on bottom for Part No. 708017.)

DIS 120124

Preference on AM radio sets in vicinity. Construct a filter as follows: Connect a .05- μ fd., 400-volt condenser in parallel with a 100,000- Ω , 1-watt resistor from the line switch side of the a.c. input plug to ground.

Unstable sync due to internal radiation. To eliminate the effect of internal radiation on synchronization circuits of the receiver, do the following:

- Add a 1500- μ fd. condenser from the "B+" side of fuse, F_1 , to chassis. (Keep the leads about $\frac{1}{4}$ " long.)
- Add a metal shield 4" long, 2" wide, along the side of the i.f. dummy lug strip.
- Change condenser, C_{T_3} , from 50 μ fd. (mica) to 42 μ fd. (ceramic, 2000 volts).
- Change condenser C_{S_1} (18- μ fd., 6000-volt mica) between the plate of the 6BG6 tube and chassis, to an 18- μ fd., 6000-volt ceramic unit.

DIS 120127B & 120128B

A shadow on the right-hand edge of the picture tube persists after the beam bender focus coil and the deflection yoke have been properly adjusted, do the following:

- Reverse the electrical connections to the focus coil.
- Magnetize the molded iron core in the deflection yoke as follows:
 - Remove V_{15} (6BG6), V_{17} (1B3), and V_{16} (6W4) from their sockets.
 - Remove the white lead from the horizontal deflection yoke at the width coil (junction of L_{11} and R_{91} , 750-ohm resistor), and connect to a "B+" 230-volt point (red lead on electrolytic condenser).
 - Connect the negative terminal of a spare 40- μ fd., 450-volt electrolytic condenser to the chassis.
 - With the set operating momentarily, touch the posi-

COAXIAL CABLES:

RG-8/U (SPECIAL) 51.5 ohms. Same size, RG-8/U. Prices: 1 to 100 ft. @ 8c per ft.—100 to 500 ft. @ 7½c per ft.—500 ft. and over @ 7c per ft. RG-34/U—71 ohms, 145 ft. length..... \$15.00

RECEIVER AND TRANSMITTER

RECEIVER BC-229 or 429—TRF Receiver with 3 Plug-in Coils to cover Freq. Range 201 to 398, 2500—4700, 4150—7700 KC. With 6 Tubes: 1/37—1/38—3/39. Power Supply required, 6 or 12 Volt & 256 Volts. Size: 16" x 8" x 7". Schematic included USED: \$8.95

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SPECIAL BUY—BOTH RECEIVER AND TRANSMITTER \$15.00

BLOWERS—115 VAC 60 CYCLE



SINGLE TYPE: (Illustrated at left) 100 CFM, 2½" intake: 2" outlet. Complete size: 5" x 6". Order No. 1C939—\$8.95

DUAL TYPE: 100 CFM, 4" intake: 2" Dis. Each Side. Complete Size: 8" x 6". Order No. 1C880—\$13.95

COMPACT TYPE: 108 CFM. Motor built inside squirrel cage, 4½" intake: 3½" x 3" Dis. Complete size: 4½" W x 8½" H x 8½" D. Order No. 2C067—\$14.50

FLANGE TYPE: 140 CFM, 3½" intake: 2½" Dis. Complete size: 7½" W x 7½" H x 6¾" D. Order No. 1C807—\$13.95

FLANGE TWIN: 275 CFM, 4½" intake: 3½" x 3" Dis. Complete size: 11¾" W x 8¾" H x 8-1/16" D. Order No. 2C069—\$21.95

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DYNAMOTOR and BLOWER: 9 Volts DC input; output 450 Volts 60 MA, 4500 RPM. At 6 Volts DC input; output 260 Volts 65 MA, 3000 RPM. Price: \$4.95

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6 or 12 Volt input; output 500 Volts 160 MA. Complete with battery cables, circuit breakers, and filter base. Prices: NEW: \$39.95—USED: \$29.95
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PE-101C DYNAMOTOR

6 or 12 Volt

(Reprints of original CQ conversion articles — Oct. and Dec., 1952 issues, furnished.)

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MP-53 BASE—Insulated type with heavy coil spring and 5" dia. insulator. Requires 2" hole for mounting. Weight: 9 lbs. \$5.95

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HR-15 as above, but with Partridge CFB Output Transformers (hermetically sealed) \$90.00

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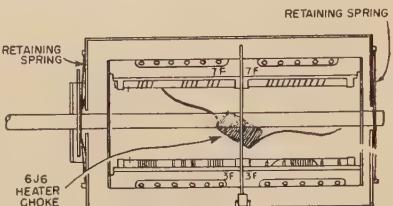
tive side of this electrolytic to pin 3 of the V_{10} (6W4, damper tube) socket.

- e. Remove the 40- μ fd. electrolytic making sure to first discharge the positive terminal to the chassis to avoid a shock.
- f. Replace tubes and reconnect yoke.

Black vertical line at left of picture.

This is generally caused by Barkhausen oscillations. After normal means (adjusting the horizontal drive condenser or changing the 6BG6) to eliminate this interference have been tried, and if the oscillation persists, do the following:

Break the cement which glues the 6J6 heater choke to the underside of the tuner chassis, and press this choke away from the chassis (toward turret). See the



accompanying diagram. This can be accomplished by removing both sets of coils for Channels 4, 5, 6, 11, 12, and 13, and then gently prying the choke loose with a screwdriver. Be careful not to damage or change the shape of the coil.

CHASSIS 120142B, 120143B

Horizontal foldover.

This condition is characterized by white hash within the left quarter of the picture which varies with the setting of the horizontal hold control.

To cure this, do the following:

1. Replace resistor R_{15} (220,000 ohms) connected through condenser C_{52} (82 μ fd.) to pin 1 of V_{10} (6SN7 horizontal control tube) with two 100,000-ohm, $\frac{1}{2}$ -watt resistors in series.
2. Connect a 25 μ fd. ceramic condenser from the junction of the two 100,000-ohm resistors to chassis ground.

Raster comes on after sound (more than one minute later).

This usually is the result of a slow-starting horizontal oscillator, and may be cured by the following:

1. Check the 6AX5 low-voltage rectifier tubes (V_{19} and V_{20}). These may have low emission causing a low "B+" voltage.
2. Change the 6BQ6 horizontal output tube (V_{10}). It may be necessary to try a few tubes since some of these may have slow heaters.
3. Check C_{50} , the 10 μ fd. "B+" boost filter condenser, and replace if leaky.
4. Check all solder connections

in the 6SN7 horizontal oscillator and control circuits (V_{19} and V_{10}).

5. In low line voltage areas change the value of R_{56} (at pin 10 of the CRT) from 22,000 ohms to 15,000 ohms.
6. Try a new horizontal phase coil L_7 and oscillator transformer T_{10} . These may have shorted turns or may be operating intermittently.

CHASSIS 120166D

Vertical roll.

When this occurs with the reception of noise interference, it may be corrected by replacing the 15-ohm resistor, R_{56} (grid resistor from pin 4 of 6SN7 vertical oscillator, V_{10} , to ground) with a 10-ohm unit.

Hiss in fringe areas

To increase the signal-to-noise ratio and reduce hiss in fringe areas, change the value of C_{50} (from volume control to ground) from .001 μ fd. to .002 μ fd.

CHASSIS 120166D, 120168D, and 120168F, & D

Picture wiggle.

This may be caused by incorrect lead dress of the picture tube leads.

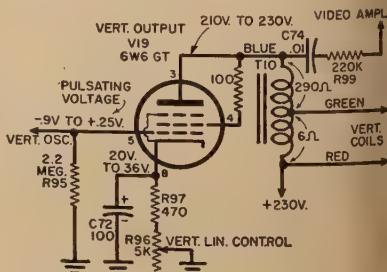
To correct this, do the following:

1. Dress the yellow lead to the cathode of the picture tube (pin 11) away from the horizontal oscillator tube (V_{19} and 6SN7) to prevent stray pickup of video information by the oscillator tube. The yellow picture tube lead can be secured to the deflection yoke support bracket.
2. Dress the white lead to the fringe compensator "on-off" switch away from the horizontal phase coil (L_{11}) and the grid of the 6SN7 horizontal oscillator tube (pin 4 of V_{10}).

CHASSIS 120168D

Popping sound in audio.

When this condition occurs at the same time that the picture starts to roll vertically or when the vertical hold control is adjusted, it may be cured by installing a 10-ohm, $\frac{1}{2}$ -watt resistor between the



screen and plate of the vertical output tube (V_{19} , 6W6), as shown in the diagram.

Hiss noise in fringe areas.

To reduce the amount of hiss, a decoupling condenser to

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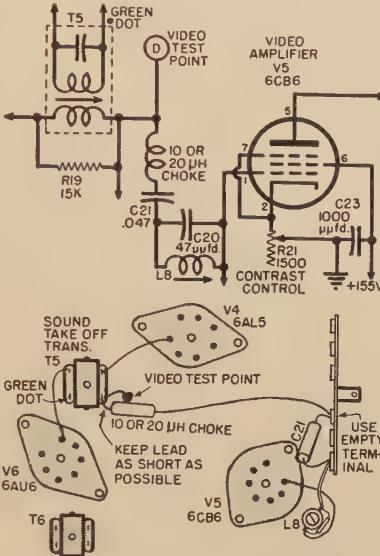
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plate circuit of the 1st audio
amplifier. This condenser should
be .001 μ fd., and should be connected
from pin 7 of V_9 (6AV6) to chassis.

*Black horizontal streaks when tuned to
Channel 6.*

This condition is usually only ap-
parent in fringe areas, and is caused by harmonics of the picture
i.f. generated in the video detector coupling to the front end, causing
regeneration of certain frequencies. In many cases it may be tuned out with fine tuning, and can sometimes affect Channels 5 or 7.

These streaks may be eliminated by connecting a 10- or 20- μ phy. r.f. choke in series with the .047 μ fd. condenser (C_{21}) connected to the grid of the 6CB6 video amplifier tube (V_5). This choke should



be connected and dressed as shown in the diagram.

In some chassis, the 4.5-mc. trap ($C_{20}-L_5$) has been eliminated. This serves to improve the sound in fringe areas.

CHASSIS 120168D, AND CHASSIS 120169B, F & D

Repeated fuse failure.

This can be caused by momentary arcs in tubes or components which occur intermittently and soon heal themselves.

To cure such fuse failure, replace the burnt-out fuse with a 6-amp. slow-blowing type.

CHASSIS 120169B & F

Yoke ringing.

This condition is characterized by a rippling of the horizontal raster lines at the left third of the picture.

To cure this effect, check condenser C_{62} which is across part of the horizontal deflection yoke coil. If this condenser is bad, it should be replaced with a new 2000-volt unit between 38 μ fd. and 62 μ fd. (Try values between these limits for the best ringing elimination.)

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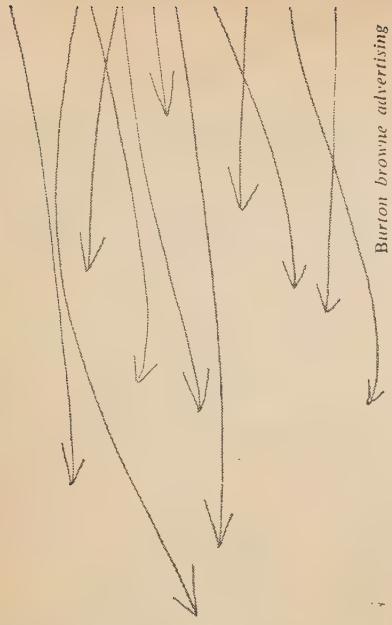


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Film for TV

(Continued from page 37)

with a white light of equal intensity, the latter gives off a highly actinic blue radiation. Photographically speaking, this fits the bill since it cuts down on the all important film exposure time.

Early TV film recording utilized a shutter that opened 170° , resulting in an exposure time of about $1/30$ th second. By accurately synchronizing the camera motor it was then possible to make the shutter open and close during vertical blanking. With this experimental device, kinescopes were recorded at a 15 frame-per-second rate.

Currently in use, a 16 mm TV recording camera is phased to the system's synchronizing generator. Its shutter, driven by a 60-cycle synchronous motor through a set of precision gears, has a closing angle of 72° . At a 24 cps rate this is equal to a single TV frame. Thus, two and one-half fields occupy one-twenty-fourth of a second which is the equivalent of one frame of 16 mm film.

Since the top portion of field 3 is unexposed during the film pulldown period, it is made up later by exposing the upper portion of field 5, before the shutter again commences its action. Two fields are therefore fully exposed since the continuity of action is at such a rapid rate.

Accurate synchronization must exist at all times. Any change, however slight, in the speed of the shutter inevitably results in banding. TV recording engineers call this "shutter bar." This may sometimes occupy a space of some ten or twelve horizontal lines running through the center portion of the picture. They may be overexposed or underexposed and exist as an unpleasant pulsating optical phenomenon.

In order to insure an extremely high degree of shutter accuracy, to-

day's drives are designed with the care and precision of a Swiss watch. The all-electronic shutter is, however, slowly gaining prominence in certain installations. The adjustments required with mechanical shutters present no problem in this system since no shutter is used.

Due primarily to economic considerations, the great majority of kinescope recordings will undoubtedly continue to be made on 16 mm film. Furthermore, fire regulations covering the use of 35 mm film are most rigorous. Consequently 16 mm technique in both kinescoping and film projection is undergoing vast improvement.

As to the future development of films and television, several noteworthy investigations are taking place simultaneously in Hollywood and Great Britain. Technically very little is known at this time regarding the video tape recording process of the Hollywood Crosby laboratories. Presumably pictures have already been produced from a rapidly moving spool of special tape!

Engineers in England are well on the way towards perfecting a method that eventually will replace existing movie making techniques. In the filming of a movie, no one but the camera operator can have a true picture of what is actually taking place on the stage. His eyes see what the film sees. Consequently two, three, or even four different shots may be taken of the same scene. It remains for the director to integrate these.

After processing hundreds of these assembled clips are projected on a screen in the screening room. Within these confines the director selects, chooses, and rejects. This rather crude, though accurate, presentation is rather costly. Now if the director had an instantaneous prevue of several camera shots on location, similar to those on TV broadcast monitors, his problems would be simplified.

Let us have a "preview" of what might occur.

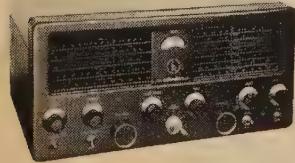
Once a director's decision is made

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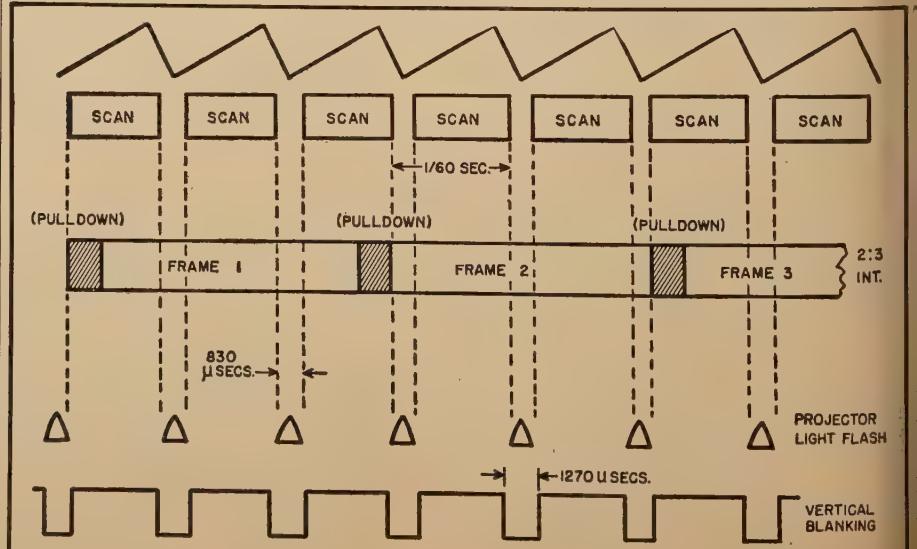
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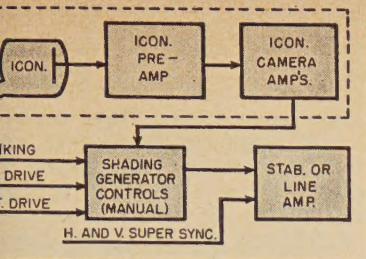
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Fig. 12. 16 mm film conversion using 2 to 3 intermittent. See text for explanation.





television film camera control chain.

In a particular shot it is communicated verbally to the technical supervisor, "Take Four." Camera #4 is lined up on the intricate dissolving console and its picture travels over a closed circuit to the recording (kinescope) studio. Here it is recorded on fine grain high quality 35 mm stock.

Special effects such as "wipes," "dissolves" and superimpositions present a problem. Modern TV techniques make use of the latter two, hundreds of times throughout a single evening transmission. As a matter of fact, one bridge was once "moved" into another small TV studio via the aid of rear screen projection!

Probably the last technical hurdle in overcoming the limiting resolution of present-day camera tubes is recording kinescopes. In the writer's opinion an idealized experimental approach would be a closed circuit system capable of passing an over-all width of some 960 lines (12 mc.). Intermediate video amplifiers are to be commercially available with up to ten, twelve, and even fifteen megahertz response.

In view of the fact that most of the transmission problems have been solved with ingenuity, it is only a matter of time until all the "bugs" have been eliminated.

It seems hardly fair to the already staggering movie industry that television has been elected to deal the death blow. The film capital's latest comeback is the three dimensional (3D) medium. TV's answer will be as follows: "Not only are we today experimenting with three dimensional color television, but we propose to have our pictures broadcast on an international scale." Truly as has been said, "In anticipation of tomorrow's miracles lies the inspiration of today's engineer!"

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6AK5	.95	6SL7GT	.62	25L6GT	.48
6AL5	.40	6SN7GT	.54	35B5	.48
6AQ5	.46	6SQ7GT	.42	35C5	.48
6AU6	.43	6T8	.77	35Z5GT	.30
6BA6	.45	6V6GT	.46	50B5	.47
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Choosing a Probe (Continued from page 42)

that the time constant of its output is short enough to pass audio frequencies.

The demodulator probe is primarily intended for observation of sweep curves and audio waveforms. In responding to the modulation envelope of an r.f. carrier, this probe is capable of accurately following the complex waveforms conveyed by modulation. The demodulated output of the probe can be measured as an a.c. voltage on a "VoltOhmyst" or it can be observed as an audio waveform on an oscilloscope. The output range of the WG-291 is flat from d.c. to 5000 cycles and, therefore, includes both the high-frequency and low-frequency components of a 60-cycle square wave, making this particular probe especially good for the observation of sweep curve response.

The input frequency response of this probe is flat from 500 kc. to 250 mc., enabling it to demodulate any video, i.f., and TV channel sweep frequencies or audio amplitude-modulated carriers within that range.

Because of its low input capacitance of $2.25 \mu\text{fd}$, the WG-291 demodulator probe can be used to observe video sweep curves or to observe i.f. amplifier curves at any stage. It is very handy for signal tracing and troubleshooting whenever modulated carriers are present, and it is particularly helpful in locating causes of hum modulation.

When the demodulator probe is used with an oscilloscope equipped with a d.c. blocking condenser, a demodulated waveform will appear at the normal vertical centering location. When used with an oscilloscope having a direct-coupled amplifier and direct-coupled input, the demodulated waveform is displaced in a positive direction by an amount proportional to the r.f. carrier level. When an unmodulated carrier is applied to the probe and its rectified output is applied to a d.c. scope, the trace is displaced in the positive direction by an amount equivalent to the peak value of the carrier.

The WG-291 demodulator probe is a peak-rectifying type which produces right-side-up video curves on any oscilloscope which is correctly polarized for upward deflection from a positive voltage.

Multiplying Probes

Safety is the prime consideration in the design of the RCA WG-289 high-voltage probe. The probe itself is a housing for a high-resistance multiplier and is shaped to minimize leakage and corona.

A 1090-megohm multiplier in a WG-289 high-voltage probe used in conjunction with a "VoltOhmyst" having 10 megohms internal resistance provides a convenient 100-to-1 voltage reduction for all d.c. ranges. The ex-

tremely high resistance causes negligible loading on TV high-volt supplies.

If it is desired to measure 19 kvolts with a high-voltage probe, "VoltOhmyst" should be set on 500-volt range to read 1.9 on the scale. The meter reading is then times 100 or 190 volts. This, in turn, is multiplied by the probe factor 100 to indicate a total of 19,000 volts.

In a unique application of the high-voltage probe, the waveforms of 15 kc. television horizontal-output at high-voltage circuits can be viewed on an oscilloscope provided that the scope has a d.c. path to ground of approximately one megohm in series with the probe resistance. Signal tracing and waveform analysis in high-voltage circuits are thereby made practical. This type of probe is not recommended for exact a.c. measurement because of stray capacitance pickup. It is advisable to shield the multiplier transistor because shielding would reduce the safety factor.

-50-

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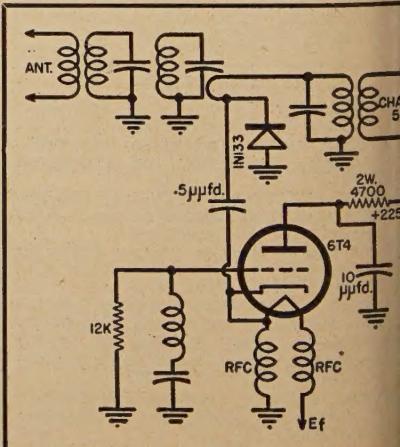
CBS-Hytron has introduced a new germanium diode which has been especially designed and tested for minor applications in the u.h.f. television spectrum from 470 to 890 megacycles.

The new Type 1N133 is housed in a glass-filled phenolic case and is especially impregnated to insure optimum performance under adverse humidity conditions.

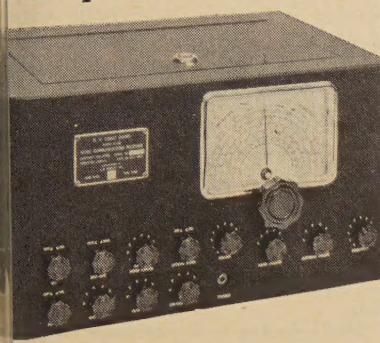
Maximum ratings at 25° C. include d.c. inverse voltage of 5 volts, a maximum (average) d.c. current of 50 mA., a maximum d.c. peak current of 1.5 ma.; surge current (1 sec. duration) 500 ma. Typical characteristics at 25° C. include: maximum reverse current at -6 volt of .3 ma.; minimum forward current (at +.5 volt) of 3 ma.; average shunt capacitance of .8 μpf ; a peak inverse voltage of 6 volts.

The germanium diode's mixer characteristics in the u.h.f. television circuit shown include oscillator injection of 1 ma., frequency of 850 mc., average conversion gain of .5, and an average noise figure of 16 db.

The new CBS-Hytron Type 1N133 germanium diode used as a u.h.f. television mi-



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Crystal Calibrator

(Continued from page 63)

band the better, as the beat note in the receiver is S-9 on the fundamental. An 80-meter crystal gives strong beats from 160 to 10 meters and is also usable on the higher bands. Decide how many crystals you want to use in this application, and with an appropriate switch, if more than one crystal is used, wire up the unit in 30 minutes. Note that the tube terminals shown in the schematic are for a 6V6.

A crystal with its fundamental frequency in any amateur band can be used for checking purposes on all of the ham bands since the circuit is rich in harmonics and subharmonics.

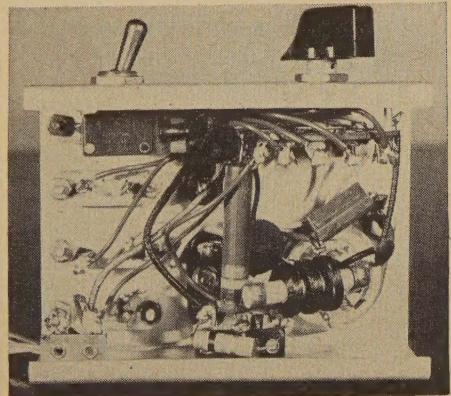
No r.f. connection to the receiver is necessary. Merely place the unit in a convenient location anywhere in the shack, or inside your receiver, if desired, and when you snap the switch "on," there is your checking signal.

The author usually operates near 7100 kc., and the crystal generally used is 3560 kc., giving a fine marker at 7120 kc.

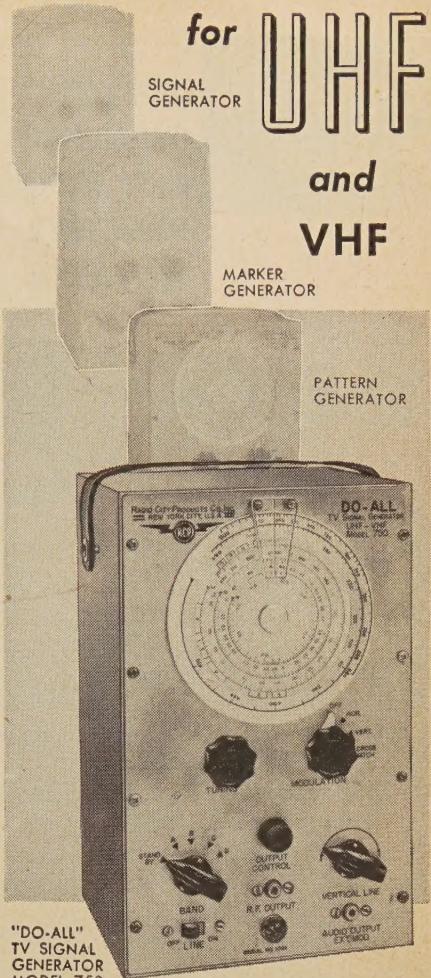
Most modern crystals are accurately calibrated and reasonably drift-free in this application. Some of the surplus crystals available at bargain prices may be of a slightly different frequency from that stamped on the holder. It would be wise to check their frequencies before depending on their accuracy. If your receiver is equipped with a vernier on the h.f. oscillator (like the modern HRO series) or an adjustable dial (like the Collins), setting it on frequency is easy and accurate. With other receivers, it is easy to interpolate mentally. If the calibrator gives a 7150 kc. signal, and zero beat on the crystal shows 7145 kc. on the receiver dial, it is obvious that within the range of 100 kc. or so, your receiver calibration is 5 kc. low.

Be sure and check the calibration every 10 or 15 minutes for the first half hour warm-up, as most receivers drift and they all vary somewhat from day to day due to differences of temperature and humidity in the shack and due to "aging" of components, as previously mentioned.

Underchassis view of the junk-box calibrator shows easy wiring of the few parts.



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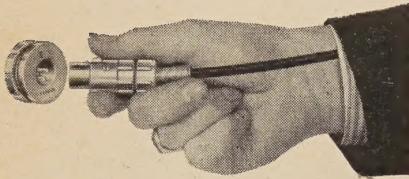
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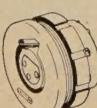
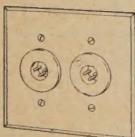
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Cannon's famous XL Connector Series for audio applications is available in 14 shell designs through Radio Parts Distributors and Electrical Wholesalers. These lightweight, compact connectors embody many desirable features: adaptable either to cord end or wall mounting applications...convenient latchlock coupling device...cable entry with compression gland and relief spring or integral clamp...tapped metal for insert retaining screw...provision for special grounding contact or grounding to shell. Accessories include dust caps and adapter shunts, receptacles for integral mounting on microphones and other audio components. Watch for the colorful Cannon counter display carton at your Radio Parts Distributor.

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Watch for this Cannon XL counter display carton.

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FCC rules provide that some method external to the transmitter be provided to insure that operation is within the assigned bands. This unit is a "natural" for this job. Establishing your receiver frequency and then zero-beating the transmitter with the receiver insures operation within the law.

The unit will be found valuable for other purposes around the shack. Adding a .0001 μ fd. condenser as shown in dotted lines on the circuit diagram gives you an exciter and keeps you on the air while you rebuild your v.f.o. and you have a choice of six frequencies at the turn of a switch, if your

unit is constructed similar to the author's. If you have a crystal of the proper frequency the 455 or 456 subharmonic or any other desired subharmonic can be used for alignment. By itself, the unit is a fine low-powered transmitter for emergency use, with a key in the negative high-voltage lead. Power can be supplied by batteries if necessary and the antenna may be connected to the dotted line point in the diagram. Dozens of other uses will come to mind. All in all, it will turn out to be a handy gadget around the shack. It will be well worth the time and money involved in its construction.

COMPACT FILAMENT AND SHORT CHECKER

By ROBERT BAXTER

THIS checker can be built with a minimum of time and expense and will test filament continuity on all types of 7-pin miniature, 9-pin miniature, octal, and loctal tubes.

Shorts may be checked between any two elements of any of the above-mentioned tube types.

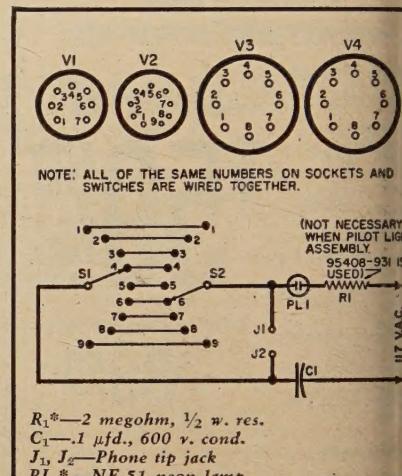
Two pin jacks have been provided for test leads which may be used to check continuity externally. When using test leads, a condenser, C_1 , is used to prevent direct contact between the a.c. line and the user's body.

All socket pins of the same number are wired together. These pins are then wired to the corresponding number on both selector switches. This combination makes it possible to select any two elements for checking.

Modifications may be made which will effect some economy including the use of wafer-type tube sockets, a less expensive

pilot light socket, etc. A small wood cabinet could be used in lieu of the metal.

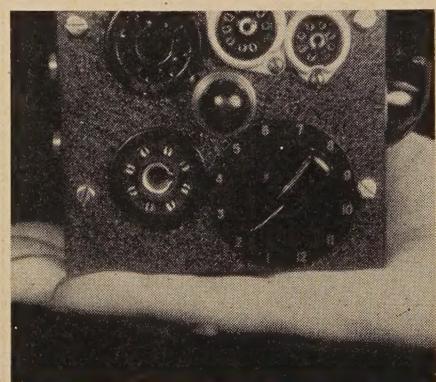
The selector switches have twelve positions, of which only nine are used. It is necessary to remember that when testing for continuity externally, the selector switches must be switched to different numbers.



- R₁*—2 megohm, $1/2$ w. res.
- C₁—.1 μ fd., 600 v. cond.
- J₁, J₂—Phone tip jack
- PL₁*—NE-51 neon lamp
- S₁, S₂—12-pos. selector sw. (Yaxley 311121—9 positions used)
- V₁—7-pin miniature socket (Eby)
- V₂—9-pin miniature socket (Eby)
- V₃—Octal socket (Amphenol 78RS8)
- V₄—Loctal socket (Amphenol 78RS8L)
- * If a pilot light assembly (Dial Light Company of America #95408-931) is used, resistor R₁ can be omitted as it is built into the assembly.

Schematic and parts list for test unit

Under chassis view showing the wiring



Over-all view of filament and short checker.

Rear view of the compact and handy tester.

